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Office of Water

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EPA and Hard Rock Mining:

A Source Book for Industry in the Northwest and Alaska

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1.0 INTRODUCTION

1.1 Purpose of this Document

This ‘Source Book’ was prepared by the Environmental Protection Agency (EPA) Region 10 Office to provide guidance on the Clean Water Act (CWA) permitting processes and associated National Environmental Policy Act (NEPA) environmental review requirements for new metal mining operations.[1] This guidance has three specific purposes. First, it is intended to explain the specific requirements of the CWA as they may pertain to new mines. It is hoped that a better understanding of EPA’s mandates and authorities will provide a basis for understanding why certain information is often requested as part of the CWA permitting processes. Second, this document describes the types of information that EPA Region 10 generally needs to process permit applications and perform environmental reviews in an efficient and timely manner. By articulating these information needs, the Region hopes that the mining industry will realize time and cost savings during the permitting process by avoiding surprises, false starts, and the need for additional gathering and/or analysis of technical data. Finally, the guidance is intended to promote predictability and consistency within Region 10 to ensure mine development, operation, and closure occur in an environmentally sound manner.

Given the unique character of each mining operation and the wide variety of environments in which they may operate, it is impractical for the Region to develop specific guidance that would apply to all sites. Consequently, this document is general in nature and applicants should not view anything in this guidance as ‘mandatory’. However, there are several questions that follow naturally from the discussions contained herein and that will be asked of most applicants. Among the most important are: Will there be a discharge of wastewater during operations and/or closure? Will the discharge meet water quality standards? What is the long-term risk of surface and ground water contamination? Will reclamation restore the integrity of aquatic and terrestrial ecosystems affected by the project? How can unacceptable environmental impacts be avoided or mitigated?

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[1]This Source Book was completed with the assistance of Science Applications International Corporation under EPA contract 68-C4-0034. Jack Mozingo and Ron Rimelman were the SAIC project managers. The project was managed by Jennifer Sachar in EPA’s Office of Wastewater Management and Bill Riley, the Mining Coordinator of EPA Region 10's Office of Water.

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1.2 Problem Statement

There is general agreement among interested parties that it is becoming increasingly difficult to permit new mines. Mining operations typically are complex undertakings that may be situated in or near complex and sensitive environments. Predicting how a particular mine may affect the environment during its active life and following closure is no simple task. In EPA Region 10, new mines present a significant challenge for those who develop CWA Section 402 National Pollutant Discharge Elimination System (NPDES) permits, review public notices and mitigation plans for CWA Section 404 Dredge and Fill permits, and review or prepare Environmental Impact Statements (EISs) pursuant to the National Environmental Policy Act (NEPA). The challenge lies largely in determining with a reasonable degree of certainty what measures are needed to assure that a technically complex operation, which is often highly exposed to the variable forces of nature, will remain in compliance with applicable laws and regulations throughout active mining as well as during and following closure.

EPA Region 10 encompasses Alaska, Washington, Oregon, and Idaho, states with environments that range from temperate coastal rainforest to alpine mountain tundra to semi-arid high plateau. Methods to characterize such diverse environments vary widely, often depending on how much information is readily available for a particular location. Also, these environments provide habitat to a range of threatened, endangered, and sensitive species, including several species of anadromous fish (e.g., salmon, steelhead). As such, the CWA permitting processes often require consultation pursuant to the Endangered Species Act (ESA) with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS). This can be a time-consuming process. Since much of the mining that occurs in Region 10 is located on Federal lands administered by the U.S. Forest Service, Bureau of Land Management, and National Park Service, proper coordination with these Federal land management agencies, who more often than not have the lead for EIS preparation, is also necessary to ensure a smooth process. Mining also may occur on State land and Tribal land in any of the states in Region 10. Regardless of land ownership and mineral or other land use rights, there are often numerous authorities at these levels that must be integrated into the overall permitting of any proposed mine. It is hoped that this document will be helpful to these agencies in understanding EPA’s authorities, information, and coordination needs in order to reach permit decisions in a timely manner.

1.3 General Suggestions for Completing the Permitting Process

Many applicants may feel that CWA permitting and associated NEPA processes are tests of endurance. This does not have to be the case. In EPA Region 10's experience, many applicants who encounter delays in acquiring mine permits have either not provided the types of data and analyses to demonstrate how their proposed operation may affect the environment during and after operation and/or they have not adequately considered feasible options that may

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be more "environmentally friendly." A common problem is that applicants do not collect data that satisfy the environmental permitting process. For example, metal constituents in surface water samples may be measured using methods with detection limits that are higher than water quality standard values. Other examples would be when geochemical or hydrological and hydrogeological studies are conducted only to satisfy objectives associated with mine development and not to help evaluate potential environmental impacts as well.

Applicants can help to minimize delays during NEPA and CWA permit application processes by considering the following general suggestions:

- Evaluate possible environmental data requirements and initiate environmental planning on the front end.
- Collect data to meet specific environmental objectives or requirements, and collect them at the required levels of detail and precision.
- Provide adequate data and analyses for all proposed alternatives.
- Be flexible when choosing facility designs, locations, and technologies.
- Propose use of treatment, disposal, and reclamation technologies with demonstrated records of success.
- Use appropriately conservative and justifiable assumptions and interpretations.
- Be pro-active in resolving potential environmental problems.
- Establish open lines of communication with the federal and state regulatory and land management agencies that will oversee the processing of the permit application(s) very early in the process, not after data are collected and planning is near completion. Maintain these lines of communication throughout the review and permitting process, and then throughout the life of the mine and afterward.
- Review data collection plans and data quality objectives with the appropriate regulatory agency *prior* to gathering the data.

Because the CWA permitting and NEPA review processes typically require an applicant to provide a variety of data at different levels of detail and precision, applicants are likely to realize cost savings by evaluating their potential data needs from the outset of a proposed project. This will enable a complete and coherent set of data to be collected efficiently and at the required levels of precision, while avoiding data gaps or overlap. In order to specifically evaluate potential impacts to surface and ground water resources, applicants may need to study an area larger than that required for the mining operation; a common approach is to use a watershed perspective.

Applicants are encouraged to evaluate different mine layouts, facility designs, and technologies in an effort to minimize the potential for environmental impact during and following operation. If newly developed or unproven treatment or disposal technologies are proposed to be used, applicants can expect to be asked to provide the results of bench- or pilot-scale tests conducted to evaluate the effectiveness of the technology and to institute more detailed monitoring to demonstrate their effectiveness.

Finally, applicants will find that impact analyses often require assumptions of future conditions, waste behavior, and land uses. This is especially true for interpretations, extrapolations, and modeling of geochemical test results and site hydrology evaluations (e.g., water balances). In all cases, applicants should aim to be conservative in their judgment of future conditions and waste behavior and be able to justify their assumptions and interpretations. As with data collection, applicants are strongly encouraged to discuss sampling and data analysis plans, including assumptions and uncertainties, with the appropriate regulators prior to performing the analyses.

1.4 Organization of this Source Book

The remainder of the main text of the source book describes the major environmental programs that apply to hardrock mining, and the types of information that EPA needs in order to issue permits, conduct reviews, and otherwise fulfill its legal obligations. Sections 2.0 and 3.0 describe Clean Water Act programs: section 2.0 provides an overview of NPDES permitting, including many of the major components of the NPDES program, and section 3.0 describes the §404 program, under which dredge and fill activities are permitted. Section 4.0 covers the National Environmental Policy Act, which requires an analysis of the environmental impacts of proposed Federal actions, including the issuance of permits. Section 5.0 covers the requirements of the Clean Air Act and the Endangered Species Act. Finally, section 6.0 summarizes the types of effects that mining can have, and the types of analyses and information that EPA expects from project proponents in applications for permits and in documents and other materials that have to be reviewed and/or approved by EPA.

The Source Book includes nine technical appendices that describe the major issues that must be understood and addressed in order to understand and control the impacts from mining operations. Appendices include the following:

- Appendix A: Hydrology
- Appendix B: Receiving Waters
- Appendix C: Characterization of Ore, Waste Rock, and Tailings
- Appendix D: Effluent Quality
- Appendix E: Wastewater Management
- Appendix F: Solid Waste Management
- Appendix G: Aquatic Resources
- Appendix H: Erosion and Sedimentation
- Appendix I: Wetlands

2.0 INTRODUCTION TO NPDES PERMITTING (CWA SECTION 402)

The objective of the Clean Water Act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (§101(a)). This is to be accomplished through the control of both point and nonpoint sources of pollution (§101(a)(7)). A number of interrelated provisions of the Act establish the structure by which the goals of the Act are to be achieved. Within this overall structure, a variety of Federal and State programs are implemented to meet the Act's requirements. Under Section 402 of the Clean Water Act, all point source discharges (see Section 2.1 for definitions) of pollutants to navigable waters of the United States must be permitted under the National Pollutant Discharge Elimination System (NPDES). NPDES permits are issued by EPA or authorized states. In Region 10, Oregon and Washington are currently authorized to implement the NPDES program, and these states issue NPDES permits that are subject to EPA review. EPA is responsible for issuing NPDES permits in Idaho and Alaska.

Figure 1 shows the NPDES permitting process. The process is summarized in the following text. Readers are referred to the *U.S. EPA NPDES Permit Writers' Manual* (EPA 1996) for more information. The primary regulations developed by EPA to implement and administer the NPDES Program are found in 40 CFR Part 122.

The NPDES application process formally begins upon submission of the application to EPA Region 10 and proceeds through a number of steps required by 40 CFR 122. Prospective applicants are encouraged to correspond with and, if appropriate, meet with Region 10 staff prior to preparing and submitting the application. Application requirements are prescribed in 40 CFR 122.21, but it is always beneficial if an open dialogue is established early to ensure that information needs are fully met, particularly information that supports both the NPDES program and NEPA. This is especially true for large complex operations, proposed operations in sensitive environments or on water quality-limited waters, or where there may be special concerns by EPA or other agencies.

In general, applicants must submit an application at least 180 days prior to discharge or permit expiration, or if a new source, prior to construction (see Section 2.1 for definition of a new source). Section 2.5 provides a summary of the information EPA typically expects to be submitted with the application. Upon receipt of an NPDES permit application, EPA conducts an initial review for completeness. In the past, EPA has found that initial applications found to be significantly incomplete inevitably result in delays in the permitting process.

Upon finding that an NPDES permit application is complete, EPA begins determining draft permit limits and conditions. The following summarizes the major components included in NPDES permits.

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- Identification and authorization of the discharge.

- Effluent limitations. Effluent limitations are restrictions on the quantity, rates, and/or concentrations of pollutants that are discharged from point sources. Effluent limits are either technology-based (based on technology-based effluent limitation guidelines) or water quality-based (based on water quality standards). In determining the need for effluent limits, EPA assesses the applicable technology-based limits and the potential for exceedances of water quality standards. Because data supplied by the permittee is critical in developing effluent limitations and most of the permit writer's time is spent in developing effluent limitations, the processes for developing effluent limitations are described in Sections 2.3 (technology-based limits) and 2.4 (water quality-based permitting).

- Monitoring and reporting requirements. Permittees are required to monitor waste streams and receiving waters to allow EPA (and/or states) to monitor changes in water quality, to evaluate wastewater treatment efficiency, and determine compliance with permit limits.

- Special Conditions. Conditions are developed to supplement effluent limitations. Examples include best management practices (BMPs), additional monitoring activities, ambient stream surveys, etc.

- Standard Conditions. Pre-established conditions are included in all NPDES permits. These conditions delineate the legal, administrative, and procedural requirements of the NPDES permit.

To accompany each draft permit, EPA prepares a fact sheet that provides facility background information, describes anticipated discharge composition and flow, describes receiving waters, and provides the basis for the proposed effluent limitation(s), monitoring requirements, and other permit conditions. The fact sheet also documents that the permit complies with other applicable statutes (e.g., the Endangered Species Act and Coastal Zone Management Act).

Draft permits are subject to a public comment period of at least 30 days. If requested by interested parties, EPA may hold a public hearing. At the end of the public comment period, EPA prepares a final permit along with supplementary documentation that responds to public comments. The final permit then includes an effective date after which the permittee must comply with all permit requirements. NPDES permits, whether issued by EPA or an authorized state, have a clear expiration date, which may be up to five years after issuance. Prior to the expiration date, permittees need to apply for new permits.

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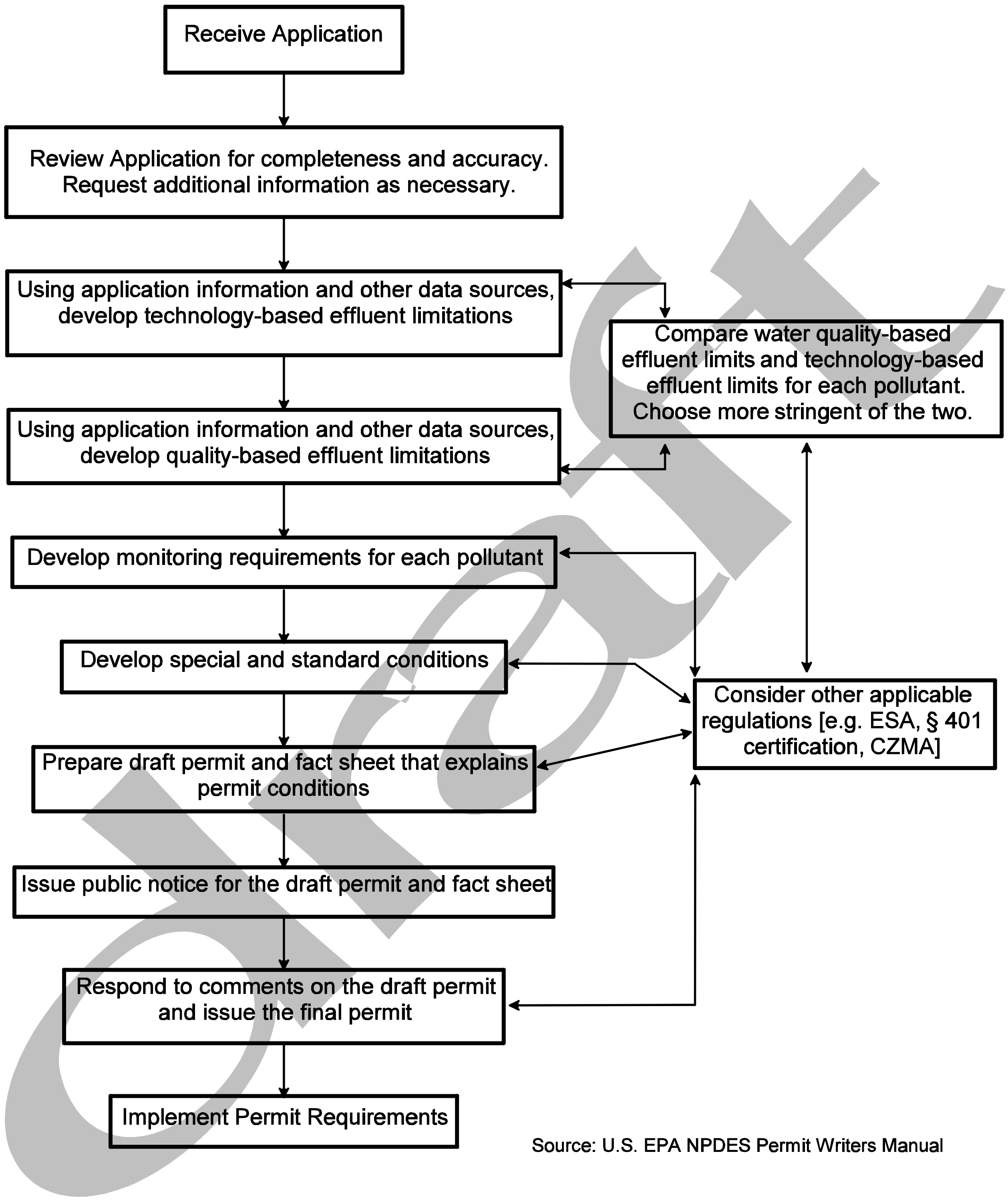

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Figure 1. NPDES Permitting Process

Before EPA can issue a permit in Idaho or Alaska, the state must certify that the discharge authorized in the permit will comply with state water quality standards (this is known as a 401 certification after the CWA section that requires it). Section 2.3 discusses state water quality standards provisions important to permitting.

EPA is not obligated to issue an NPDES permit to any mine operator. EPA may reject a permit application if the agency believes that discharges would not comply with Clean Water Act provisions and/or anticipated permit conditions. For example, EPA would not issue a permit to facility where proposed discharges are not expected to meet technology- or water quality-based effluent limitations (see 40 CFR 122.4 *Prohibitions*).

The following sections describe key aspects of the NPDES permitting process for mining discharges. Section 2.1 describes when an NPDES permit is needed. Section 2.2 discusses the technology-based effluent limitation guidelines which are national standards that apply to effluent discharges from hardrock mines. Section 2.3 summarizes key aspects of water quality standards related to NPDES permitting and describes how water-quality based effluent limits are developed. Section 2.4 describes storm water permitting and Section 2.5 provides an overview of the information that EPA needs in order to issue an NPDES permit.

Because of the complexities and site-specific factors associated with projecting NPDES permit requirements, EPA strongly recommends that mine operators coordinate with EPA and states early in the planning process. This will assist in evaluating options for wastewater management practices and identifying NPDES information needs.

2.1 When is an NPDES Permit Needed?

As noted in Section 2.0, NPDES permits are required for any discharge of a pollutant from a point source to waters of the U.S. The term "point source" is defined very broadly under the Clean Water Act, in part because it has been refined through over 25 years of litigation. It means any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container (see 40 CFR 122.2). Similarly, the term "water of the U.S." is defined very broadly under the Clean Water Act and through years of litigation. It means navigable waters, tributaries to navigable waters, interstate waters, the oceans out to 200 miles, and intrastate waters which are used by interstate travelers for recreation or other purposes, as a source of fish or shellfish sold in interstate commerce, or for industrial purposes by industries engaged in interstate commerce.

Given these broad definitions, nearly any discharge from a mine could be considered a point source. In general, three discrete categories of discharges from mining operations require NPDES permits: process wastewater, mine drainage, and storm water. Definitions of each are provided in Table 1. NPDES permit applicants are encouraged to communicate with EPA or an authorized state to determine how to categorize discharges and to discuss the permitting process.

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Table 1. Categories of Discharges from Mines	
Process wastewater	"...any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product." (40 CFR 122.22) See Section 2.3 for discussion of effluent limitation guidelines applicable to process wastewaters.
Mine drainage	"...any water drained, pumped, or siphoned from a mine." (40 CFR 440.132) [See Table 3 for definition of "mine."] See Section 2.3 for discussion of effluent limitation guidelines applicable to mine drainage.
Storm water (associated with industrial activity)	"... the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. ...[T]he term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or byproducts used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at 40 CFR part 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water.... For the purposes of this paragraph, material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, finished product, byproduct or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas." (40 CFR 122.26(b)(14). Note that a permit is NOT required for "...discharges of storm water runoff from mining operations ... which are not contaminated by contact with or that has not come into contact with, any overburden, raw material, intermediate products, finished product, byproduct or waste products located on the site of such operations." (40 CFR 126(a)(2)) See Section 2.4 for a discussion of storm water permitting.

For new dischargers, EPA's NPDES regulations [40 CFR § 122.21(a)] require prospective dischargers (in States without an approved NPDES program) to submit, prior to beginning onsite construction, information to the EPA Region that will allow a determination by EPA of whether

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the facility is a “new source”. “New source” is defined as any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced after promulgation of applicable new source performance standards (see Section 2.2 for discussion of new source performance standards). Specific criteria that EPA uses to determine whether or not a discharge is a new source are in 40 CFR § 122.29. In general, most new mining operations are defined as new sources. Construction at existing facilities may represent a new source depending upon the age of the facility.

If the facility is determined to be a new source, 40 CFR 122.29(c) provides that the issuance of the NPDES permit is subject to the environmental review requirements of NEPA, and thus to EPA’s NEPA regulations at 40 CFR Part 6 Subpart F. In cases where NEPA applies, EPA expects the permit applicant to begin the environmental review process by preparing an Environmental Information Document (EID) with the NPDES permit application (see Section 4.0). In preparing a draft new source NPDES permit, the administrative record on which the draft permit is based must include the EID prepared by the applicant, the environmental assessment (and, if applicable, the FNSI) prepared by EPA, and/or the environmental impact statement (EIS) or supplement, if applicable. In addition, public notice for a draft new source NPDES permit for which an EIS must be prepared cannot take place until the draft EIS is issued [40 CFR Part 124.10(b)].

2.2 Technology-based National Effluent Limitation Guidelines

Section 301(b)(2) of the Clean Water Act requires technology-based controls on effluents. These technology-based controls are established in effluent limitation guidelines (ELGs). Section 304(b) of the Clean Water Act requires EPA to promulgate regulations providing ELGs that set forth the degree of effluent reduction attainable through the application of the "best practicable control technology currently available" (BPT) and the "best available technology economically achievable" (BAT). For new industrial dischargers (new sources), §§304(c) and 306 require EPA to promulgate "new source performance standards" (NSPS) based on "best available demonstrated technology."   To move toward the Act's goals of eliminating the discharge of all pollutants, existing industrial discharges were required to achieve these ELGs by specific dates: BPT ELGs by 1977 and BAT by 1983. All new sources are required to meet NSPS from their inception.

The current ELGs for the ore mining and dressing industry were promulgated by EPA in 1978 (BPT) and 1982 (BAT and NSPS). The ELGs for the ore mining and dressing industry are found at 40 CFR Part 440, which applies generally to facilities classified with Standard Industrial Classification (SIC) code 10; this includes and is limited to the mining and milling of metalliferous ores (this discussion does not include placer gold mines, for which the ELGs at 40 CFR Part 440 Subpart M were promulgated in 1989 and take a somewhat different form than the rest of Part 440). Other than gold placer mining, EPA has divided the ore mining and dressing category into 11 subcategories based on the type of ore mined and milled. The subcategories for which EPA has established ELGs for one or more types of discharges are shown in Table 2.

For the various subcategories, there are ELGs for two types of discharges: "mine drainage" and “process” wastewater. The latter generally includes effluent from mills (such as water contained in tailings) and other concentration (or, in RCRA terms, “beneficiation”) operations, such as dump and heap leach operations. See Table 1 for definitions of mine drainage and process wastewater. The ELGs specify numeric limitations, and contain various applicability conditions and exemptions. For certain mills in some subcategories, the NSPS ELGs allow no discharge except in net precipitation areas, where so-called “zero discharge” facilities may discharge only the volume of water that represents the excess of annual precipitation over annual evaporation. Under certain conditions, Part 440 provides a "storm exemption" from applicable ELGs for discharges from qualifying facilities in all subcategories. Tables 2 and 3 provide an overview of the requirements of Part 440. Table 2 shows the types of ELGs that have been promulgated for the various subcategories and the types of limits established for these categories. Table 3 presents certain definitions (e.g., of "mine”) as well as a summary of the storm exemption.

It is worth noting that ELGs are established for only a limited number of the pollutants that are likely or known to be present in the discharge from metal mines and mills (for example, the ELGs establish concentration limits for only one or a few metal pollutants, although a suite of heavy metals may generally co-occur in discharges). Compliance with the ELGs is intended to ensure that other metals present in the discharge are adequately treated. The ELGs’ technology-based concentration levels are considered the baseline for discharges.

A semantic distinction is also worth noting. Although the ELGs establish technology-based limits, neither the ELGs nor other regulations require the use of any particular technology, and this fact is often misunderstood. Rather, the ELGs require that discharges achieve at least a comparable level of treatment as the technology on which the limit is based.

Any applicable limitations and conditions that are specified in the ELGs must be incorporated into the NPDES permit. Therefore, it is critical that permit applicants adequately characterize their operations and discharges so that it can be determined which ELGs apply. Predicting a water balance and maintaining proper water management are critical to ensuring compliance with the “zero discharge” provisions of certain of the ELGs. Water balance issues are discussed in more detail in Appendices A and E. As noted throughout this document, early consultation with EPA is strongly recommended. With the advent of the storm water program (section 2.4), consultation with EPA to ensure discharges are correctly characterized has become

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Table 2. Industry Sectors and Types of Applicable Limits 40 CFR Part 440	
Industry sectors covered by subparts	Types of limits placed on discharges
Subpart (Subcategory): A Iron ore B Aluminum ore (bauxite) C Uranium, Radium, and Vanadium ores D Mercury ore E Titanium ore F Tungsten ore G Nickel ore H Vanadium ore (when mined alone) I Antimony ore--reserved J Copper, Lead, Zinc, Gold, Silver, and Molybdenum ores (except gold/silver placer, which is in subpart M) K Platinum ores	Subparts A, B, C, D, E, F, G, H, J, K: Numeric limits on mine drainage. Subparts A, C, E, F, G, H, J, K: Numeric limits on process waste water discharges from certain mills Subparts A, C, D, J: Zero discharge allowed from certain mills except, if precipitation exceeds evaporation on annual basis. Such facilities may discharge the difference (net precipitation) and discharges must meet mine drainage limits. Subpart J: Zero discharge allowed from certain mills, except that discharge may be allowed if contaminant buildup in recycle water interferes with ore recovery; this requires operator to make such a demonstration.

Table 3. Selected Definitions and Provisions in 40 CFR Part 440
Selected Definitions
§440.132 "Active mining area" "a place where work or other activity related to the extraction, removal, or recovery of metal ore is being conducted, except with respect to surface mines, any area of land on or in which grading has been completed to return the earth to desired contour and reclamation work has begun." "Mine" Active mining area, including "all land...used in or resulting from the work of extracting metal ore or minerals from their natural deposits by any means or methods,..."
Selected Provisions
§440.131(b) and (c) Storm exemption for discharge and no discharge facilities in subcategories A,B,C,D,E,F,G-H,J,K: Facilities designed/constructed/maintained to contain or treat normal process water and 10-year/24-hour precipitation may qualify for exemption from ELG limits. 10-year/24-hour volume includes runoff from all active mine areas that is not diverted. Development document provides details on qualifying for "excursion:" 12 other paragraphs describing meaning of "contain" and "treat" and further explaining the scope of storm exemption.

even more important. Figure 2 gives an example of the care with which discharges must be examined and characterized in order to determine their regulatory classification. As can be seen, both the source of discharge and the ways in which discharges are managed (segregated versus

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mixed, for example) affect the regulatory classification and thus the applicable standards and requirements.

For discharges or pollutants not covered by the ELGs, EPA uses Best Professional Judgement (BPJ) to develop technology-based limits. In addition, when technology-based limits will not ensure compliance with applicable water quality standards for the receiving waters, permit writers develop more stringent water quality-based limits (see section 2.3).

Information on implementation of ELGs in permits can be found in the *Permit Writers Manual*. More information on the development of ELGs for the ore mining and dressing industry is found in *The Development Document for Effluent Limitations Guidelines and Standard for the Ore Mining and Dressing Point Source Category* (EPA 440/1-82/061).

2.3 Water Quality Standards and Water Quality-Based Permitting

In addition to the technology-based limits discussed in the previous section, EPA evaluates proposed discharges to determine compliance with Section 301(b)(1)(C) of the CWA. This section of the Act requires the establishment of limitations in permits necessary to meet water quality standards. In deciding whether or not water quality-based effluent limits are needed, EPA first determines whether the discharge would cause, has the reasonable potential to cause, or would contribute to an excursion of water quality criteria. If a "reasonable potential" exists, then water quality-based effluent limits are calculated for that parameter. The permitted effluent limit for a particular pollutant will be the more stringent of either the technology-based or water quality-based limit.

Where there is a "reasonable potential", EPA also develops water quality-based effluent limits for whole effluent toxicity (WET). WET is defined as the total toxic effect of an effluent measured directly with a toxicity test. WET is a useful parameter for assessing and protecting against impacts upon water quality caused by the aggregate effect of a mixture of pollutants in the effluent. EPA develops water quality-based effluent limits according to the guidance in *Technical Support Document for Water Quality-Based Toxics Control* (EPA 1991; also called the "TSD"). More general information on water quality-based permitting can be found in the *Permit Writers Manual*.

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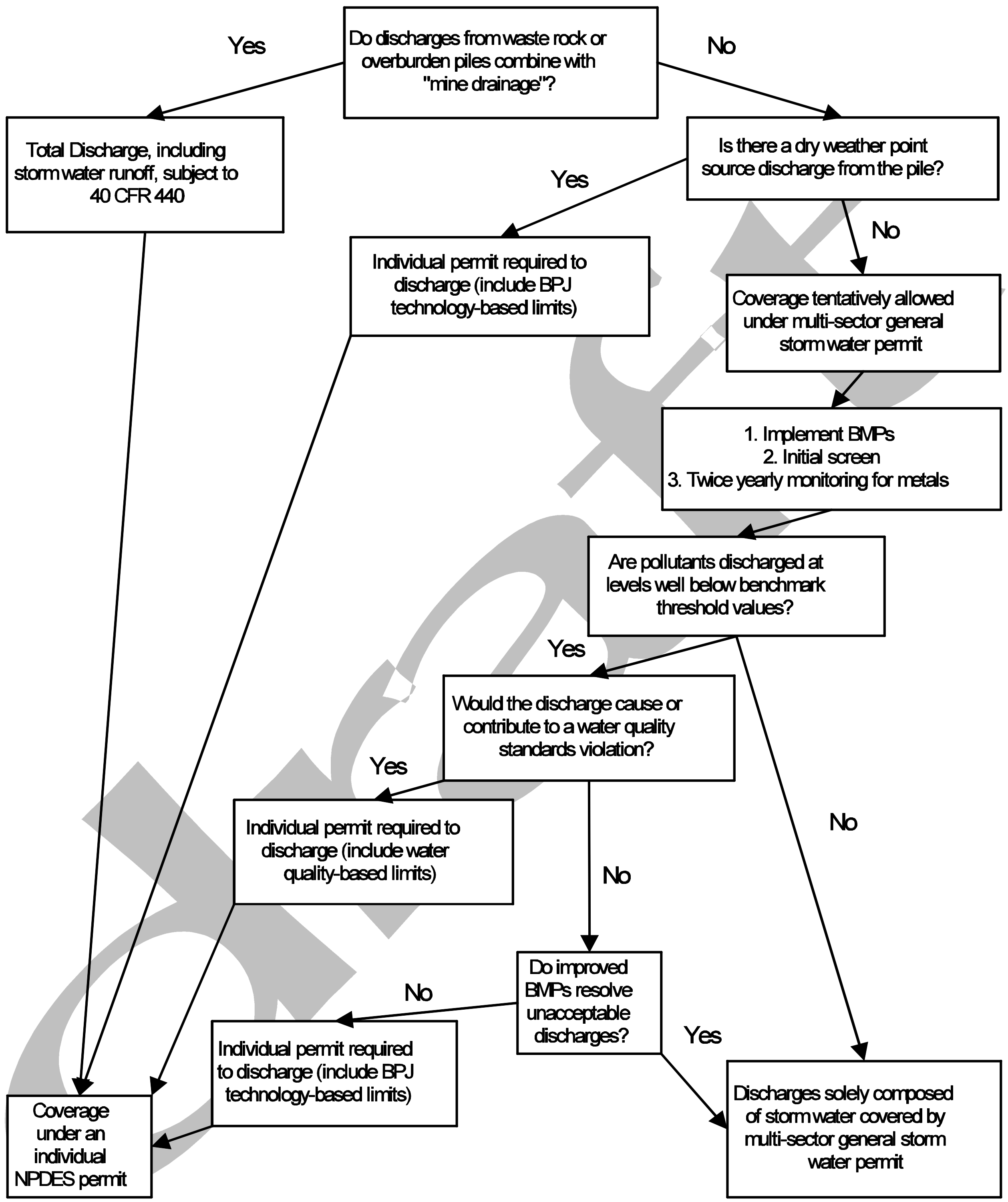

Figure 2. Example of Discharge Classification Depending on Wastewater Source and Management

Information used to determine the need for and to develop water quality-based effluent limits includes:

- Applicable receiving water quality standards
- Characteristics and variability of the effluent
- Characteristics and variability of the receiving water
- Where appropriate, dilution of the effluent in the receiving water (mixing zone).

Because the receiving water quality standards are key to developing water quality-based effluent limits, a brief discussion of water quality standards and mixing zones is presented below. Various provisions of water quality standards are also discussed in Appendix B and D.

Water Quality Standards Under Section 303(c) of the Clean Water Act, States are required to develop water quality standards to protect public health, enhance the quality of water, and serve the purposes of the Clean Water Act. EPA's regulations for State development of water quality standards are at 40 CFR Part 131. All 50 states have developed water quality standards that EPA has approved.

EPA has found that correctly identifying applicable water quality standards often poses significant challenges for mine project proponents. Since many projects will include direct or indirect discharges to surface waters, knowing the applicable standards is essential to determining whether a project will adversely affect the environment and whether there is a need for water quality-based effluent limits. Baseline monitoring programs and evaluation of potential impacts to surface water should be tailored towards being able to determine whether standards will be met.

Water quality standards consist of three major components:

- **Designated Uses**: All water bodies in a State are classified based on expected designated uses. Typical designated uses include public water supply, recreation, and propagation of fish and wildlife. Different segments of a water body may have different uses. This is important because both impact predictions and water quality-based effluent limits must consider downstream uses.

- **Water Quality Criteria:** Section 303 of the Clean Water Act requires states to adopt criteria sufficient to protect the designated uses for State waters. These criteria may be numeric or narrative. Numeric water quality criteria are typically expressed as levels, constituent concentrations, or toxicity units. Narrative criteria are statements that describe water quality goals, e.g., "free of objectionable color, taste, or odor" or "free from toxics in toxic amounts." EPA requires States to develop mechanisms to implement narrative criteria. For water bodies with multiple designated uses, multiple criteria also apply. The most stringent of the applicable criteria is used to develop water quality-based effluent limits.

Of note for mining sites is that water quality criteria for some metals are hardness dependent. Also, some state water quality criteria for metals are presented in different forms (total, total recoverable, or dissolved). However, NPDES regulations require that permit limits be expressed as total recoverable. Where the criteria are different, EPA uses default translators to translate between total and dissolved. EPA uses default translators unless the permittee develops approvable site-specific translators (see Appendix B).

- **Anti-degradation:** Each State must adopt an anti-degradation policy. State policies must incorporate three components. First, existing uses must be maintained and protected. Second, where water quality is higher than necessary to protect designated uses, that quality must be maintained and protected unless degradation is shown to be necessary for social and economic reasons and other alternatives are not available. Third, waters that are designated as Outstanding Resource Waters may not be degraded.

Mine operators should initially obtain the applicable State water quality standards and regulations. These can be obtained directly from State agencies. Most are also now available from State government websites on the Internet. Each State must review its water quality standards every three years, although more frequent changes to standards and regulations are common. Operators must obtain the most recent standards and remain up-to-date on changes throughout the permitting process. This further emphasizes the need for frequent communication with State agency personnel to anticipate potential standard modifications that could affect project planning and evaluation.

Mixing Zones. Mixing zones allow for concentrations of pollutants to exceed water quality criteria in small areas immediately around discharge points prior to full mixing of effluent and the receiving waters. Under the Clean Water Act, States have the authority to determine whether they will allow mixing zones and under what conditions. As such, each State has different mixing zone provisions. The sizes of mixing zones are often determined based on low flow stream conditions, i.e., when the least dilution is available in the receiving water. In addition, available dilution is dependent on background constituent concentrations. A discharger must apply to the appropriate state agency for a mixing zone and the state must certify the mixing zone for EPA to use it in developing permit limitations. A mass balance, modeling, or other mixing zone assessment is generally required to support a mixing zone application. In addition, some

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states may require a biological assessment to support the mixing zone. Mixing zones are discussed in more detail in Appendix B.

Site-specific Criteria and Reclassification. States typically have provisions for establishing site-specific criteria for individual constituents in a specific water body. Such criteria often allow for higher constituent concentrations than state-wide criteria because the individual water body can be demonstrated to achieve designated uses at the higher levels. Mine operators who elect to pursue site-specific criteria will be required to provide extensive chemical and biological testing for the water body. They need to work closely with State agencies in developing any requests for site-specific criteria. In addition, EPA needs to be consulted because site-specific criteria require EPA approval since they represent changes to the State water quality standards. Modifications to state standards also require public involvement.

If a water body is not being used for a designated use, mine operators can pursue re-classification. The criteria under which a designated use may be removed are generally defined at 40 CFR Part 131.10(g). Requests for re-classification are also complex and require close coordination with State agencies and EPA. In addition, 40 CFR Part 131.10(h) specifies where designated uses cannot be removed. Specifically, designated uses cannot be removed if they are existing uses, unless more protective uses are applied.

Total Maximum Daily Load (TMDL). Section 303(d) of the CWA requires States to identify water bodies that are not meeting their assigned designated uses (e.g., water bodies that exceed the water quality criteria). Section 303(d) also requires states to develop TMDLs (total maximum daily loads) for these water quality-limited water bodies. A TMDL is a determination of the amount of a pollutant, or property of a pollutant, from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water-limited water body. The TMDL defines waste load allocations for point sources that discharge to the water body. These waste load allocations are developed into permit limits. New mine proponents should ascertain whether surface waters in the project vicinity have been included on the 303(d) list and, if that is the case, the reasons for not attainting the water body’s designated uses. If there are listed water bodies, coordination with EPA and State agencies is essential to determine the status of any TMDLs and how the listing could affect NPDES permit requirements.

2.4 Storm Water

In addition to the development of effluent limits and conditions for discharges of wastewater, the NPDES Program also includes provisions for control of storm water discharges. As indicated in section 2.1, storm water associated with industrial activity includes any discharges from conveyances directly related to manufacturing, processing or raw materials storage areas at industrial facilities. On August 7, 1998, EPA published in the *Federal Register* a further clarification of the applicability of the effluent guideline requirements for mine drainage

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and the applicability of EPA's storm water regulations to runoff from waste rock and overburden piles (63 FR 42533-42548). Figure 2 illustrates how discharge from a waste rock pile may be classified as either wastewater (i.e., mine drainage) or storm water. In summary, EPA's storm water regulations generally apply to most storm water discharges from active mine sites where the storm water discharges are not commingled with process/mill water or mine drainage. The only areas exempt from the storm water regulations are those not directly associated with the active mining operation or potential pollutants (e.g., parking lots and office areas).

Storm water associated with industrial activity at mine sites may be permitted in two ways, either by an individual facility-specific NPDES permit or by a general permit. Facilities may be required or request to be covered under an individual permit. In some cases, the facility may wish to consolidate regulation of process and storm water discharges under a single comprehensive individual NPDES permit. In other cases, EPA or a delegated State may require an individual permit to address facility-specific conditions (e.g., the necessity for water quality-based limits for discharges to streams in certain cases.)

Unlike discharges of process wastewater where numerical effluent limits (technology-based and/or water quality-based) are used to control the discharge of pollutant, the primary permit condition used to address discharges of pollutants in a facilities storm water is a pollution prevention plan or best management practices (BMP) plan. All individual permits for storm water discharges issued by EPA will include a requirement to develop a BMP plan. BMPs are defined in 40 CFR 122.2 as "... schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce pollution of 'waters of the United States.' BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal or drainage from raw material storage." See Appendix E and H for more information on development of a BMP Plan. Beyond the BMP plan, permits may include other requirements (such as monitoring) based on the Best Professional Judgment (BPJ) of the permit writer and as necessary to ensure compliance with water quality standards.

Due to the nature of the discharge (storm water) and the large number of facilities requiring permit coverage, EPA has developed general permits[2] under which storm water discharges from mining facilities may be permitted. A mining facility may be covered under EPA's Multi-Sector General Permit for Mining Activities. The sections of this permit applicable to hardrock mining facilities primarily include requirements for development of Storm Water Pollution Prevention Plans which incorporate BMPs and monitoring provisions. As required by the August 7, 1998

[2]EPA has determined that certain categories of discharges, including many categories of storm water discharges, are more appropriately controlled by a "general" permit rather than by individual permits for each discharge. General permits are issued under the provisions of 40 CFR 122.28 and contain eligibility requirements as well as the specific requirements that applicants must follow in order to have their discharges authorized under the permit.

Federal Register, storm water discharges from waste rock and overburden must be more extensively tested as part of application submission and during permit coverage. This includes sampling and analysis for metals.

The Multi-sector General permit contains some eligibility restrictions—that is, they prohibit certain discharges from coverage under the permit (see, for example, Part I.B.E(a) - (h) of the Multi-Sector Permit). EPA (and authorized states) also have the discretion to deny general permit coverage to any discharge and require an individual permit. Therefore, the agency recommends that mine operators coordinate with EPA prior to submitting an application or request for coverage.

2.5 Information Needs for NPDES Permitting

In order to issue an NPDES permit, EPA and authorized States need extensive information about the proposed facility and the anticipated discharges. Application and information requirements are specified in the following sections of the regulations:

- 40 CFR 122.21(f): Information requirements for all applicants.
- 40 CFR 122.21(g): Application requirements for all existing dischargers.
- 40 CFR 122.21(h): Application requirements for facilities that discharge only non-process wastewater.
- 40 CFR 122.21(k): Application requirements for new sources and new discharges.
- 40 CFR 122.26(c): Application requirements for facilities that discharge storm water associated with industrial activity.

Table 4 identifies the various forms that these sections require to be submitted and the types of information required by each. Copies of the forms may be obtained from EPA and authorized states[3].

[3] Forms also are available via the Internet at http://www.epa.gov/owm/npdes.htm or http://www.epa.gov/owm/swlib.htm.

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Table 4. EPA Forms Required for NPDES Application		
Form number	Applicant	Information type
EPA 3510-1 (Form 1)	All new permits and renewals	Basic information on the facility, location, owner, etc.
EPA 3510-2C (Form 2C)	Existing dischargers	Detail information on discharge sources, locations, volumes, sources, treatment, characterization.
EPA 3510-2D (Form 2D)	New sources and discharges	Similar to Form 2C, but some data may have to be estimated.
EPA 3510-2E (Form 2E)	Discharges of non-process wastewater	Information on discharge, chemistry, treatment, etc
EPA 3510-2F (Form 2F)	Storm water associated with industrial activity (individual permit)	Detailed information on storm water sources and characteristics.
EPA 3510-6	Storm water associated with industrial activity (general permit)	Notice of Intent for discharge(s) to be covered under multi-sector general permit (see section 2.4)

Table 5, below, provides an overview of the types of information generally needed to develop an NPDES permit. The table references the Source Book appendices where additional information regarding information needs may be found. The magnitude and extent of the information needs described in Table 5 may depend on site-specific factors. Permit applicants should consult with EPA and the certifying State agency early in the planning process to ensure that appropriate data is collected. This is particularly the case where the permittee applies for a mixing zone, elects to develop translators or site-specific criteria, or where threatened or endangered species may be present.

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Table 5. Overview of Information Needs for NPDES Permitting		
Information Type	Data Needs	Source Book Appendix
Description of wastewater management and water balance	Outfall locations and topographic map	n/a
	Identification of sources of pollutants and sources of wastewater	Appendix E and F
	Hydrologic characterization, water balance	Appendix A
	Description of wastewater treatment	Appendix E
Effluent characteristics and variability	Flow, chemical, physical and WET characterization	Appendix D
Receiving water characteristics and variability	Flow, chemical, physical, and biological characterization	Appendix B
Storm water characterization	Topographic map	
	Flow, chemical analysis, physical analysis	Appendix D
	Description of BMPs	Appendix E
Determination of available dilution	Mixing zone assessment, modeling	Appendix B
Site-specific assessments	Aquatic resources characterization	Appendix G
	Development of translators	Appendix B
	Development of site-specific criteria	Appendix B

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3.0 DISCHARGE OF DREDGED OR FILL MATERIAL TO WATERS OF THE U.S. (SECTION 404)

Section 404 of the Clean Water Act addresses the placement of dredged or fill material into waters of the U.S. and has become the principal tool in the preservation of wetland ecosystems. Wetlands subject to regulation under Section 404 are those areas that meet the criteria defined in the 1987 Corps of Engineers' Wetland Delineation Manual. Section 404 regulatory authority is shared between the EPA and the Corps of Engineers (COE or Corps). Section 404(a) establishes the authority for the COE to issue permits for discharges of dredged or fill materials into "waters of the U.S." at specified disposal sites. Permitted disposal sites must comply with EPA's §404(b)(1) guidelines. In addition, §404(c) gives EPA "veto" authority to prevent or reverse COE permit issuance at specified disposal sites. In practice, EPA only exercises its veto power in rare instances where the proposed disposal site is of significant resource value, and where EPA and the COE cannot resolve disputes through the normal public notice review process.

Section 404(e) establishes that the Corps may issue general permits on a State, regional, or National basis for categories of activities that the Secretary of the Army deems similar in nature, cause only minimal adverse environmental effects, and have only a minimal cumulative adverse effect on the environment. General permits may be issued following public notice and a period for public comment; the permits must be based on the §404(b)(1) guidelines and establish conditions that apply to the authorized activity. Exceptions to §404 requirements are established in §404(f) and conditionally include the construction of temporary roads for moving mining equipment. Applicants are strongly encouraged to check with the local COE District office regarding general permits and special conditions that may be in effect in the area in which they propose to mine. Often there are state-specific conditions imposed, particularly with respect to Nationwide Permits.

The process of issuing an individual §404 permit begins with a permit application. The application typically contains information describing the project, project area, and project purpose; wetlands and other "waters of the U.S." that could potentially be directly or indirectly impacted; and mitigation, monitoring and maintenance plans. The §404(b)(1) Guidelines require the proponent to demonstrate that the selected project alternative is the least environmentally damaging practicable alternative. It is important to note that the preferred alternative selected during the NEPA analysis may not be the least environmentally damaging practicable alternative. In addition, it should be noted that an alternative does not necessarily have to involve only land currently owned or controlled by the proponent. It can involve actions (mitigation, for example) on land that could be easily obtained by the proponent.

It is thus important to avoid and/or minimize all impacts to wetlands and other waters of the U.S. to the fullest extent possible. For proposed fill in 'special aquatic sites', which include wetlands, there is a rebuttable presumption against the need to fill for non-water dependent activities. A Memorandum of Agreement (MOA) between the COE and EPA, dated February 6, 1990, establishes the policy and procedure in determining the type and level of mitigation necessary to comply with the §404(b)(1) Guidelines. The MOA sets 'no net loss' of wetland

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functions and values as a national goal and defines the types of mitigation, for practical purposes, as minimization and compensatory. Although compensatory mitigation is often the focus of project proponents, from a regulatory perspective, avoidance and minimization should be the focus of any project with the potential to impact wetlands and other waters of the United States. A project description submitted as part of an environmental impact assessment or permit application should clearly demonstrate how avoidance and minimization have been addressed.

The COE evaluates the application based on requirements of the CWA, including the §404(b)(1) guidelines, and based on comments received from public notice reviewers, which typically includes the EPA. Since the issuance of §404 permits are subject to NEPA review, the COE then prepares an environmental assessment or, in some cases, an EIS (or contributes to another agency's EIS as a cooperating agency) and issues a statement of finding. A permit is then issued or denied based on the finding. EPA may exercise its veto authority (§404(c)) at anytime during the permit application process, or even prior to a permit application being filed.

As was recommended above for NPDES permit applications, it is highly advisable for applicants for §404 permits to consult with the Corps of Engineers and other appropriate regulatory and resource agencies prior to submission of the application. This facilitates a mutual understanding of the resource issues of concern and can enable early identification of alternatives that avoid and/or minimize impacts and allows for early input on mitigation requirements and design. This early consultation can significantly reduce the time that might otherwise be necessary. The Corps has released a number of Regulatory Guidance Letters that were most recently published in the *Federal Register* on March 22, 1999 (61 FR 13783-13788). These can be accessed through the COE website at http://www.usace.mil, which also includes extensive information on COE regulatory programs. Appendix I - *Wetlands* contains information related to wetlands terminology, characterization, and impact assessment.

Enforcement authority is divided between the Corps and EPA: the Corps provides enforcement action for operations discharging in violation of an approved permit while EPA has primary authority over any operation discharging dredged or fill materials without a §404 permit.

4.0 THE NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) of 1969 became law on January 1, 1970 (Pub. L. 91-190, 42 U.S.C. 4321 *et seq.*). NEPA serves as the basic national charter for environmental protection. The law requires every federal agency to analyze and describe potential environmental effects that could arise from any action or legislation proposed by that agency. NEPA provides for public participation through public notices of intent, the solicitation of public comment, and as appropriate, public hearings.

The general framework for implementing NEPA requirements is presented in regulations issued by the Council on Environmental Quality (CEQ) which may be found at 40 CFR Parts

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1500-1508. In general, the analysis and identification of the impacts of proposed federal actions, and alternatives to those actions, are presented in environmental assessments (EAs) and/or, for "major federal actions significantly affecting the quality of the human environment," in Environmental Impact Statements (EISs). Each of these terms is defined in CEQ's regulations (40 CFR Part 1508) and refined in EPA's (40 CFR Part 6)). Over the past 25 years, the NEPA framework for environmental review of proposed Federal actions has been substantially refined, based on further congressional directives, action by CEQ, and an extensive body of case law.

Each federal agency has developed its own rules for NEPA compliance that are consistent with the CEQ regulations but address its own specific missions and program activities. EPA's NEPA regulations are at 40 CFR Part 6.

4.1 EPA's NEPA Role

Under NEPA, EPA can serve as a lead agency, cooperating agency, or reviewing agency. Most EPA decisions and actions are not subject to NEPA, or the decision making process that leads to proposed EPA actions has been determined to be functionally equivalent to that required by NEPA. The major exception to this in the case of mining is the issuance by EPA of NPDES permits subject to new source performance standards (see section 4.2). The decision whether to issue such a permit is subject to NEPA, and thus the environmental impacts of permit issuance must be analyzed and documented in an EA and/or EIS. Where an EIS is required, EPA is either the lead or, more commonly, a cooperating agency in preparing the EIS.

Lead Agency. In some instances, delineated at 40 CFR 1501.5, more than one agency's action is subject to NEPA. In such cases, one of the agencies becomes the lead agency (or there are co-lead agencies). When an EPA action is subject to NEPA, EPA generally serves as the lead agency for proposed projects that do not involve federal lands but that include actions over which EPA has jurisdiction by law. For example, EPA would likely be the lead agency under NEPA for a proposed project on private lands that requires a new source NPDES permit in a State where EPA is the NPDES permitting authority (see 40 CFR, Part 6, Subpart F). EPA can also serve as a lead agency when tribal lands and public lands are involved and where EPA's permitting authority is broader in scope than another agency's. In addition, EPA is responsible for NEPA review to support proposed legislation that significantly affects environmental quality as outlined in 40 CFR 6.102(b). As described in 40 CFR 6.604(g), EPA may prepare NEPA documentation using agency staff, by contracting with a consulting firm, or by using a 'third party agreement' between the applicant, EPA, and a contracting firm. The 'third party' approach is most often used for large mine projects where EPA is the lead agency. Under this approach, the EPA is responsible for directing the contracting firm while the applicant pays the costs. The responsibilities of lead agencies are outlined in 40 CFR § 1501.5.

Cooperating Agency. Federal agencies that have jurisdiction by law, but that are not lead agencies, may be cooperating agencies upon request by the lead agency (40 CFR 1501.6). As a cooperating agency, EPA participates in the scoping process and, upon request of the lead agency, may assume responsibilities for developing information and preparing portions of NEPA documents pertaining to the agency's areas of expertise. For example, EPA generally serves as a cooperating agency whenever a mine is proposed on National Forest Service or Bureau of Land Management land and requires that EPA issue an NPDES permit to construct and/or operate. Depending on the types of expertise available to the Forest Service, EPA may play a significant role in efforts to predict effluent quality and evaluate potential water quality impacts.

Reviewing Agency. Under Section 309 of the Clean Air Act, EPA is required to review and comment in writing on all major Federal actions. The Agency reviews and prepares written comment on every draft EIS prepared by other agencies, and assigns a rating to the environmental impact of the proposed action and to the adequacy of the draft EIS (see section 4.3). The comments are available to the public, and the ratings and a synopsis of the comments are published in the *Federal Register*. When EPA has serious concerns about the impacts of the proposal or the adequacy of the EIS, the Agency consults with the lead agency. EPA also reviews final EISs, particularly ones where significant issues were raised in earlier comments. EPA comments on final EISs, but not its ratings, are made available to the public and a synopsis of comments is published in the *Federal Register*.

If EPA's review of a final EIS determines that a proposed action is or remains "unsatisfactory from the standpoint of public health or welfare or environmental quality," EPA refers the matter to the Council on Environmental Quality in accordance with 40 CFR Part 1504. .

4.2 EPA Requirements for Environmental Review Under NEPA and the CWA

40 CFR Part 6 outlines EPA's policies and processes for identifying and analyzing the environmental impacts of EPA-related activities and for preparing and processing EISs. Subpart A of the Procedures provides an overview of the Agency's purpose and policy, institutional responsibilities, and general procedures for conducting reviews. Subpart A outlines EPA's basic hierarchy of NEPA compliance documentation as follows:

- **Environmental Information Document (EID)**, which is a document prepared by applicants, grantees, or permittees and submitted to EPA. This document must be sufficient in scope to enable EPA to prepare an environmental assessment.

- **Environmental Assessment (EA)**, which is a concise document prepared by EPA, or by a contractor under EPA's direction, that provides sufficient data and analysis to determine whether an EIS or finding of no significant impact is required.

- **Notice of Intent (NOI)**, which announces the Agency's intent to prepare an EIS. The NOI, which is published in the Federal Register, reflects the Agency's finding that the proposed action may result in "significant" adverse environmental impacts and that these impacts cannot be eliminated by making changes in the project.

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- **Environmental Impact Statement (EIS)**, which is a formal and detailed analysis of alternatives including the proposed action, undertaken according to CEQ requirements and EPA procedures. Guidelines that describe the focus and intent of EISs are provided in 40 CFR 1502.2. EISs must provide rigorous, unbiased analyses of potential impacts from the proposed action and its alternatives, determine whether unavoidable adverse environmental impacts would occur, and describe any irreversible and irretrievable commitments of resources. The treatment of environmental impact, which generally receives close scrutiny, must consider connected actions, cumulative actions, and similar actions (40 CFR 1508.25).

- **Finding of No Significant Impact (FNSI)**, which announces EPA's finding that the action analyzed in an EA (either as proposed or with alterations or mitigating measures) will not result in significant impacts. The FNSI is made available for public review, and is typically attached to the EA and included in the administrative record for the proposed action.

- **Record of Decision (ROD)**, which is a statement published in the *Federal Register* that describes the course of action to be taken by an Agency following the completion of an EIS. The ROD typically includes a description of those mitigating measures that will be taken to make the selected alternative environmentally acceptable.

- **Monitoring**, which refers to EPA's responsibility to ensure that decisions on any action where a final EIS is prepared are properly implemented.

Subpart B of EPA's Procedures provides a detailed discussion of the contents of EISs. This subpart specifies the format and contents of an executive summary, the body of the EIS, material incorporated by reference and a list of preparers.

Subpart C of the Procedures describes requirements related to coordination and other environmental review and consultation requirements. NEPA compliance involves addressing a number of particular issues, including: (1) landmarks, historical, and archaeological sites; (2) wetlands, floodplains, important farmlands, coastal zones, wild and scenic rivers, fish and wildlife, and endangered species; and (3) air quality. Formal consultation with other agencies may be required, particularly in the case of potential impacts to threatened and endangered species and potential impacts on historic or archaeological resources. Section 5.2 discusses the Endangered Species Act consultation process.

Subpart D of the Procedures presents requirements related to public and other Federal agency involvement. NEPA includes a strong emphasis on public involvement in the review process. Requirements are very specific with regard to public notification, convening of public meetings and hearings, and filing of key documents prepared as part of the review process.

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Subpart F presents environmental review procedures for the New Source NPDES Program. This Subpart specifies that the requirements summarized above (Subparts A through D) apply when two basic conditions are met: (1) the proposed permittee is determined to be a new source under NPDES permit regulations (see Section 2.1); and (2) the permit would be issued within a State where EPA is the permitting authority (i.e., that State does not have an approved NPDES program in accordance with section 402(b) of the CWA. In EPA Region 10, Alaska and Idaho do not have approved NPDES programs). This Subpart also states that the processing and review of an applicant's NPDES permit application must proceed concurrently with environmental review under NEPA. Procedures for the environmental review process are outlined. Subpart F also provides criteria for determining when EISs must be prepared, as well as rules relating to the preparation of RODs and monitoring of compliance with provisions incorporated within the NPDES permit. Additional information that is not relevant to the New Source process can be found in Subparts E, G, H, I, and J of the Procedures.

Of particular importance to new source NPDES permit applicants is preparing the Environmental Information Document (EID). It is highly recommended that applicants confer with EPA regarding the scope of the EID as a well prepared EID will make the ensuing NEPA process run much more smoothly. In general, an EID should address the following (adapted from EPA Region 6, *EID Handbook*, 1995):

- An effective **description of the project**, with an emphasis on project features which cause environmental changes, and with alternatives to those features.

- A concise description of the **environmental setting** where the project takes place, with an emphasis on resources which are highly valued, very sensitive to change and/or certain to be affected by the project.

- Evidence that the project has been designed and located, and will be built and operated, to reasonably **minimize adverse environmental changes** and to improve environmental benefits.

- The applicant's own assessment of **environmental impacts or changes.**

- Discussion of **cumulative environmental effects** which would result from interaction with other activities in the same watershed, same airshed or same economic region.

- Documentation that necessary **coordination** regarding special resources has taken place with certain Federal and state agencies (e.g., Corps of Engineers, U.S. Fish and Wildlife Service, State Historic Preservation Officer).

Section 6 provides guidance on information needs related to NEPA analyses.

4.3 When is an EIS Required?

The determination of whether or not an EIS is required is important as it impacts the nature and extent of data that needs to be collected and analyses that need to be performed to determine the environmental impacts of a proposed project (and project alternatives). NEPA requires that an EIS be prepared for "major" Federal actions "significantly affecting the quality of the human environment." Generally, the determination of the need for an EIS hinges on finding that the proposed action would result in significant adverse impacts.

EPA's procedures provide general guidelines and specific criteria for making this determination (40 CFR 6.605). General guidelines are (40 CFR 6.60.5(a)):

- EPA shall consider both short- and long-term effects, direct and indirect effects, and beneficial and adverse environmental impacts as defined in 40 CFR § 1508.8.

- If EPA is proposing to issue a number of new source NPDES permits within a limited time span and in the same general geographic area, EPA must consider preparing a programmatic EIS. In this case, the broad cumulative impacts of the proposals would be addressed in an initial comprehensive document, while other EISs or EAs would be prepared to address issues associated with site-specific proposed actions.

EPA's specific criteria for preparing EISs for proposed new source NPDES permits are found in 40 CFR 6.605(b):

- The new source will induce or accelerate significant changes in industrial, commercial, agricultural, or residential land use concentrations or distributions, which have the potential for significant effects. Factors that should influence this determination include the nature and extent of vacant land subject to increased development pressure as a result of the new source, increases in population that may be induced, the nature of land use controls in the area, and changes in the availability or demand for energy.

- The new source will directly, or through induced development, have significant adverse effects on local air quality, noise levels, floodplains, surface water or ground water quality or quantity, or fish and wildlife and their habitats.

- Any part of the new source will have significant adverse effect on the habitat of threatened and endangered species listed either Federally or by the State.

- The new source would have a significant direct adverse impact on a property listed or eligible for listing in the National Register of Historic Places.

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- Any part of the new source will have significant adverse efforts on parklands, wetlands, wild and scenic rivers, reservoirs or other important water bodies, navigation projects, or agricultural lands.

The determination of significance can be challenging. CEQ provides some guidance in the form of a two-step conceptual framework which involves considering the context for a proposed action and its intensity (40 CFR 1508.27). Context can be considered at several levels, including the region, affected interests, and the locality. Intensity “refers to the severity of the impact.” CEQ lists a number of factors to be considered when judging severity, including:

- Effects on public health and safety

- Unique characteristics of the geographic area

- The degree to which effects are likely to be controversial

- The degree to which effects are uncertain or involve unique or uncertain risks

- Cumulative effect of the action

- Whether the action would threaten a violation of Federal, State, or local law or regulation.

The nature of the mining industry can make it particularly difficult to assess significance. Potential impacts are often uncertain, they often are delayed in time from the permitting action, and they can be quite controversial. In addition, impacts may occur in environments previously degraded by mining or other activities, or environments where naturally occurring pollutants contribute to environmental degradation. Again, it is essential for applicants to coordinate with EPA early in the planning process to determine the data needed in order for EPA to prepare an EIS. Section 6 describes the general information needed for EISs on new mining proposals.

5.0 OTHER AUTHORITIES

5.1 Clean Air Act

Clean Air Act (CAA) provisions apply to a wide range of emissions sources from mine sites, including stack/point sources and fugitive sources. Fugitive emissions are generally defined as sources that are not easily controlled (e.g., conveyors can be controlled while open piles cannot). CAA requirements are generally applied through several different types of programs. These requirements can be described by three categories: (1) new source permits, including prevention of significant deterioration (PSD) and non-attainment permits, (2) new source performance standards (NSPSs), and (3) State Implementation Plan (SIPs) requirements for non-attainment areas. Title V of the 1990 CAA Amendments provides for consolidation of different CAA requirements into single facility permits. EPA's permitting authority is generally limited to "major" sources. States generally have exclusive permitting authority under CAA Section 110A(2)c for minor sources. Beyond permitting, EPA must evaluate compliance with applicable air quality requirements for all new or modified sources associated with proposed actions that are subject to NEPA.

Where an operator proposes a new point source or modifications to an existing point source, the entire facility must be reviewed for air quality impacts. Separate requirements apply to major and minor sources. Major source determinations are based on the emissions of six parameters from point sources, including: NO_x, SO_2, CO, VOCs, particulates, and lead. Most facilities are major sources if they emit more than 250 tons per year of any of these pollutants. Comparison of source emissions with these threshold values includes expected reductions to be provided by proposed control measures. Most large mines generally trigger at least one of the threshold values for the six parameters and are typically major sources.

There are two categories of new source reviews/permits: PSD analyses/permits for facilities in attainment areas, and non-attainment analyses/permits for facilities located in non-attainment areas. Non-attainment is measured through compliance with the National Ambient Air Quality Standards (NAAQS) for the six pollutants. A facility in a non-attainment area may undergo a combination of both PSD and non-attainment analyses: PSD for pollutants that are achieving ambient air quality standards and non-attainment analyses for specific pollutants that are causing the non-attainment designation.

PSD requirements include the use of Best Available Control Technology (BACT) for all emissions sources, stack/point source emissions and fugitives. In addition, total emissions from a site must not cause exceedances of NAAQS. EPA ensures compliance with NAAQS through pollutant "increments." The applicable increments for a site depend on facility location. There are nationwide increments for "Class I" and "Class II" areas. Class I areas lie within 50 kilometers of federally protected lands such as National Parks. More stringent increments may be established on an airshed-specific basis depending on background air quality and number and types of sources. In general, facilities that only affect Class II areas do not present issues related to BACT not meeting the increments. However, facilities located within or that can affect Class I areas often present difficulties, because the national Class I increments are very stringent and individual areas can establish even more stringent air quality related values (AQRVs). Modeling is used under PSD to determine compliance with Class I and II increments.

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5.1.1 New Source Performance Standards

As noted above, the PSD and minor source programs address facility-wide air emissions. Under CAA Sections 111/112, EPA has also established minimum national new source performance standards (NSPSs) for emissions of certain pollutants discharged from specific types of industrial units and operations. This includes metallic mineral processing (40 CFR Part 60 Subpart LL) and non-metallic mineral processing (40 CFR Part 60 Subpart 670). Mineral processing is generally defined as extraction and beneficiation operations associated with transport and beneficiation of ore, including conveyor belt transfer points, screens, crushers, storage bins, thermal dryers, and truck and railroad loading and unloading. Underground operations are excluded. The NSPSs include opacity and particulate matter limits from each point source. In addition, there is an opacity standard for particular matter that escapes from containment systems.

5.1.2 Specific Sources

Table 6 summarizes the applicability of specific Clean Air Act programs to individual sources at mining operations, generally in the context of whether emissions are fugitive or stack emissions, and mobile or stationary sources.

Table 6. Potential Emission Sources at Mine Sites

Source	Applicability/Authorities
Overburden, Waste Rock, Tailings, and Spent Ore	Fugitive and mobile sources (vehicles); except for Hazardous Air Pollutants (HAPs), EPA has limited authority to control fugitives unless there is a major point source; for major new sources, can require BACT, LAERs, and other controls needed to comply with PSD/non-attainment requirements; emissions from uranium mill tailings, asbestos mine wastes, and phosphate rock (radionuclides) specifically covered by NESHAPs
Land Application	Wet process, little or no CAA applicability
Waste Materials Re-use	Primary CAA applicability is National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for asbestos and radionuclides emissions related to re-use of waste materials containing asbestos; phosphate rock containing radionuclides; etc.
Chemical Storage	For wet storage, little or no CAA applicability; for dry, considered fugitives as discussed under waste rock, tailings, and spent ore above

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Table 6. Potential Emission Sources at Mine Sites	
Source	**Applicability/Authorities**
Ore Handling and Piles	Open piles - fugitives; Covered storage piles/areas and conveyors - point sources; conveyor transfer points, covered storage areas, truck and railroad unloading areas covered by NSPS (opacity and particulates)
Heap and Dump Leaches	Mostly wet and not relevant; where dry, fugitives
Process Ponds	Wet - little or no applicability
Mine Pit	Major source of fugitive and vehicle emissions, new technology-based standards for off-road vehicles to be established under Title II; two current interpretations for vehicles - (1) national - subject to stationary source permitting as point source, EPA authority largely dependant on major/minor determination, and (2) Region X - mobile source, exempted from permitting, but considered by EPA under NEPA.
Underground Workings	EPA policy decision that all vents from underground mines are stationary sources and must be evaluated under NEPA and CAA; permitted as point sources; uncertain how widely applied
Blasting	Above ground - fugitives, underground - see underground workings
Vehicle Use	See mine pits above, haul roads also major sources of fugitives
Construction	Exempted from permitting as temporary activity; SIPs typically have generally applicable requirements (e.g., must not cause nuisance)
Reclamation/Post-reclamation	Theoretically should be covered under new source permitting, major/minor source issue effects authority; could also be addressed as part of permit modification; may not be being considered
Inactive/Abandoned Mines	Except under CERCLA, ongoing activity should be same regulatory and permitting requirements as active operations; CERCLA actions exempted from permitting but still must meet standards (PSD, NSPS, etc.)
Generators	Point sources, may bring some entire mine sites into major source requirements; also lower major source threshold for PSD/non-attainment analysis may arise if greater than about 75 Mw

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Generators	Point sources, may bring some entire mine sites into major source requirements; also lower major source threshold for PSD/non-attainment analysis may arise if greater than about 75 Mw

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of the proposed action, and determines if there is likely to be an effect (either beneficial or adverse) on any listed species. The BA is then filed with the Services. If species and/or habitat are present and the project involves actions other than "major construction activity," the Federal agency must still evaluate the potential for adverse effects and consult with the Services. This may consist of preparing a Biological Evaluation (BE) or other type of report to evaluate these effects.

If the BA or BE concludes that the proposed agency action "is likely to adversely affect" any of the T&E species, formal consultation with the Services is required.

Formal consultation involves a more detailed review of the proposed action by the Services. The formal consultation process determines whether a proposed agency action(s) is likely to jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat. It also determines the amount or extent of anticipated incidental take of a listed species. After collecting the best available scientific and commercial information on the listed species, and reviewing the Federal Agency's BA or BE, the Services prepare a Biological Opinion (BO) that analyzes the impacts of the proposed action on the listed species. Three possible conclusions are made in the BO: the proposed action (1) may promote the continued existence of the species; (2) is not likely to jeopardize the continued existence of the species; or (3) is likely to jeopardize the continued existence of the species. When the Services make a determination that the proposed action is likely to jeopardize the continued existence of the species, reasonable and prudent alternatives must be included in the BO. Reasonable and prudent alternatives are alternative actions that can be implemented in a manner consistent with the scope of the Federal agency's action, that are economically and technologically feasible, and that the Services believe would avoid jeopardy or adverse modification to the listed species, or critical habitat, respectively. The BO may also include reasonable and prudent measures to minimize impacts (i.e., amount or extent, or incidental take).

Concurrent with planning for permitting and NEPA review, it is essential that proposed mine operators work with the lead agency and the Services to plan for ESA compliance. Biological surveys need to fully address the presence of proposed, candidate, threatened, and endangered species and/or their habitat. Potential impacts need to be considered in preparing plans of operations and permit applications. The lead agency will be responsible for ensuring that final plans of operations/permitted activities are consistent with the findings of the Biological Opinion. Specific reasonable and prudent measures and alternatives as well as monitoring requirements identified in the Biological Opinion may be incorporated directly into NPDES or other permits and Records of Decision issued by EPA.

Non-Federal representatives (e.g., proposed mine operators) may participate in the informal consultation process, including preparing draft BAs. The lead agency must designate such representatives in writing to the Services. Regardless, ultimate responsibility for compliance

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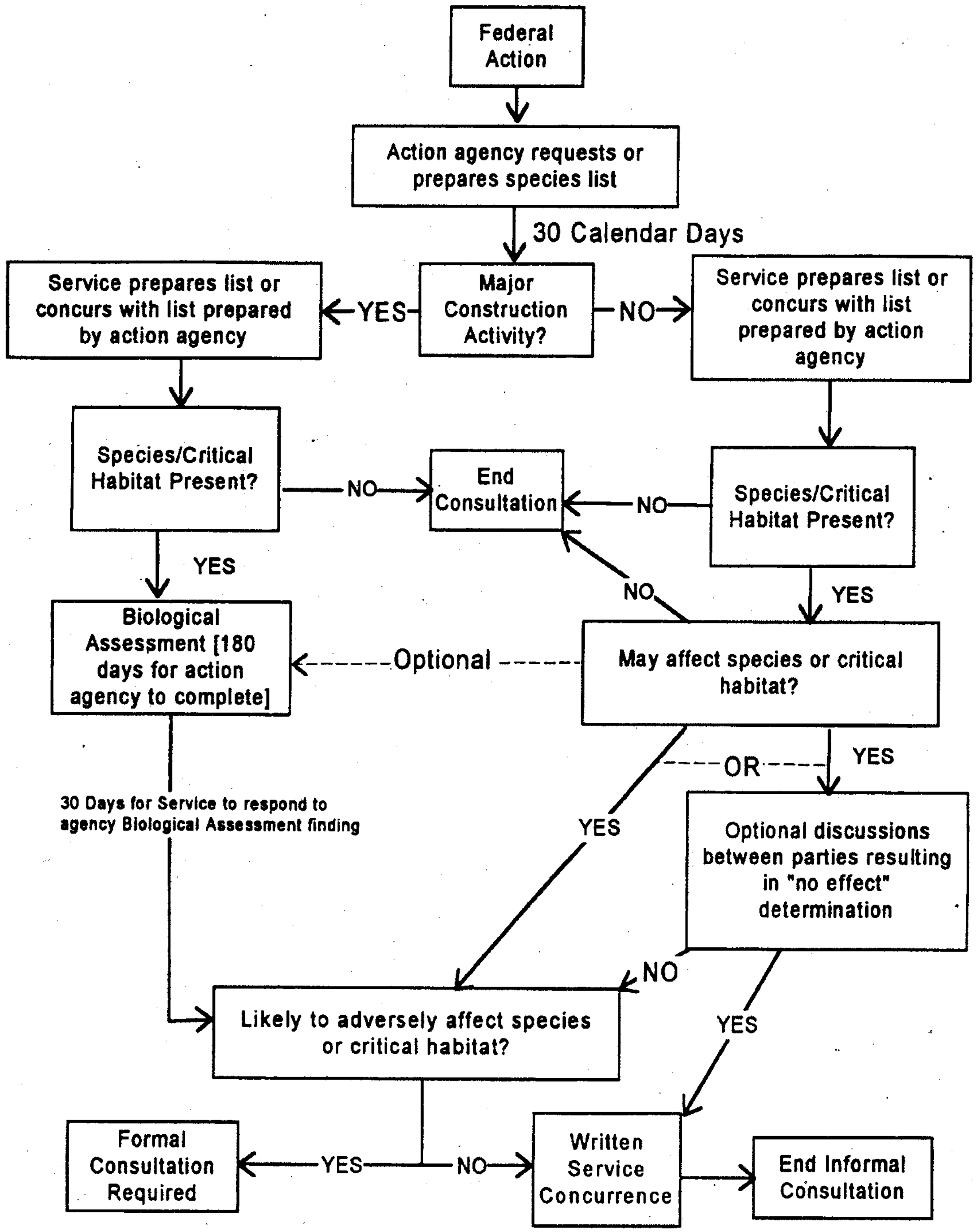

Figure 3A. Informal Consultation Under the Endangered Species Act

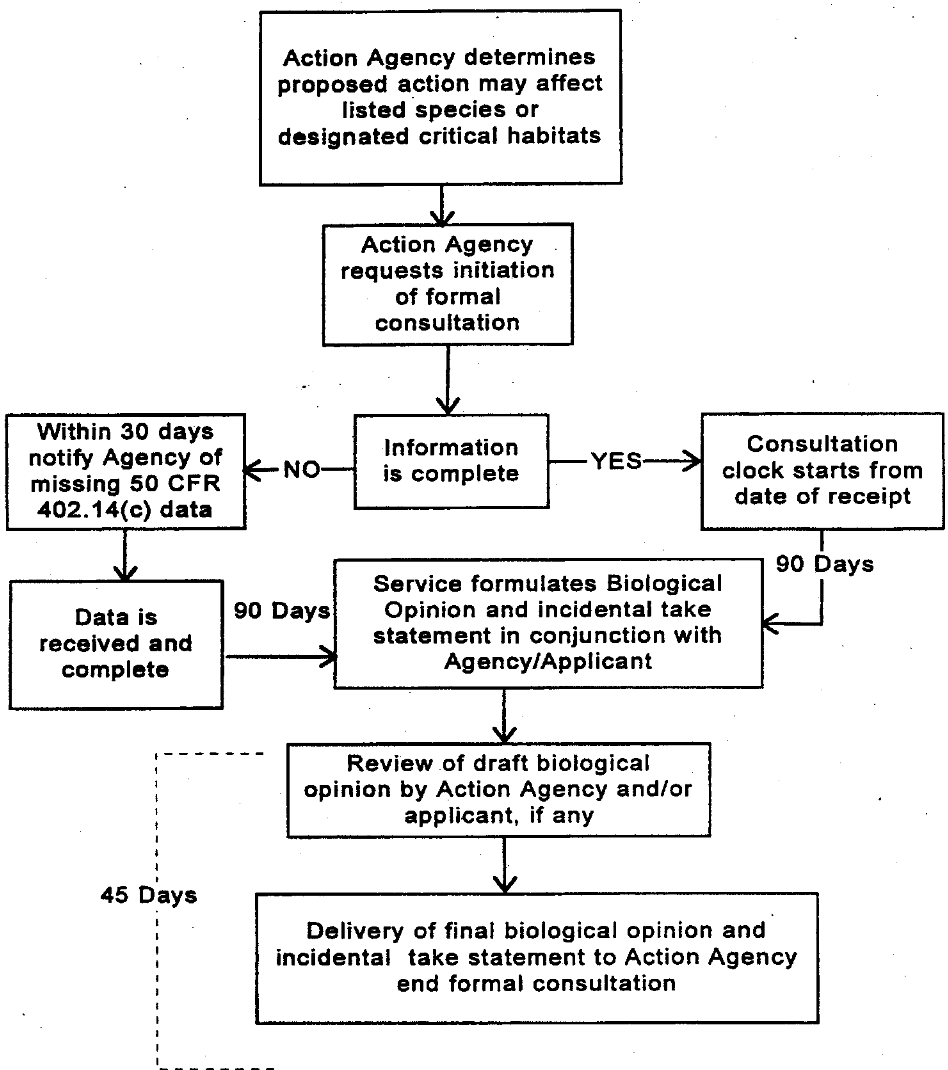

Figure 3B. Formal Consultation Under the Endangered Species Act
(USFWS and NMFS, *Endangered Species Consultation Handbook, 1998)*

with Section 7 requirements remains with the lead agency (e.g., assuring that draft BAs are technically sound). More information about the Act and consultation process is found in the Endangered Species Consultation Handbook published by the Services in March 1998. This document is available from the USFWS website at www.fws.gov.

6.0 EPA EXPECTATIONS FOR MINING IMPACT ASSESSMENT

As discussed in Section 4, EPA's primary direct responsibilities in Region 10 typically relate to NPDES new source permitting of mines under the CWA and associated NEPA review. At the same time, many of the most significant issues regarding potential environmental impacts from new mining operations involve water resources, aquatic habitat, jurisdictional wetlands and other waters of the U.S. Consequently, EPA expects applicants to have a thorough understanding of the hydrological and aquatic environment in which they are proposing to work. The NEPA review and CWA permitting processes will require that an applicant collect a variety of data, conduct different types of analyses, and develop preliminary facility and operational designs to define potential consequences on water resources. Examples of the types of data, testing, and analysis that may be required are given in Tables 7 through 10. Tables 7 through 10 in turn refer to the technical appendices for more details. A general discussion of information needs related to predicting impacts to surface water, ground water, and wetlands resources are presented in the following sections.

6.1 Impacts to Surface and Ground Water Hydrology

Applicants need to address whether and to what extent their proposed project will affect the surface water and ground water hydrology at the mine site and within the watershed. To determine potential hydrological impacts will require collection and analyses of a variety of meteorological and hydrological data (see Table 7), preparation of operation phase and closure phase water balances (see table 10), and wastewater and storm water management plans. Information regarding surface water discharge, precipitation, and the duration and intensity of storm events are especially critical to this process. This is because most proposed sites are located in mountainous, coastal, or subarctic areas where there are significant annual and seasonal variations in climate that make it difficult to develop data sets that are representative and statistically significant. To overcome the problems associated with high short-term data variability requires a long-term record. However, most sites are likely to be proposed in remote areas for which long-term records of discharge and climate are unlikely to be available either for the watershed of interest or for nearby watersheds possessing similar physical characteristics. Consequently, in order to gather data for as long as possible, applicants should establish stations to monitor stream discharge and meteorological conditions during the early stages of site exploration. Information and analyses necessary to determining impacts to surface water and ground water hydrology is discussed in the following sections and in more detail in Appendix A, *Hydrology*.

6.1.1 Surface Water Hydrology

A proposed mining project can impact the quantity and velocity of surface water flow by altering natural drainage patterns and the infiltration/runoff relationships in a watershed; discharging storm water and wastewater; impounding water; changing the character of gaining and losing stream reaches through mine dewatering; mining through stream channels and flood plains; and by diverting, re-routing, and channelizing streams. Importantly, many mining activities have the potential to alter the equilibrium balance between flow and sediment transport in streams (Johnson, 1997). Altering this equilibrium causes stream gradients, channel geometries, channel patterns, and stream banks to adjust to new equilibrium conditions that reflect new erosion and sediment transport characteristics (Johnson, 1997). Such changes can disrupt aquatic habitats both upstream and downstream of a mine. The creation of waste dumps, tailings impoundments, mine pits and other facilities that become permanent features of the post-mining landscape can cause fundamental changes in the physical characteristics of a watershed (O'Hearn, 1997). Consequently, applicants may be required to assess the effect of these changes on the post-mining hydrological environment.

Most applicants will be required to complete hydrological studies and a site water balance in order to predict impacts to surface water hydrology. These studies and their associated data needs are summarized below and are described in more detail in Appendix A, *Hydrology.*

The *hydrological study* should provide a baseline from which to measure or predict changes that might occur as a consequence of the proposed action and its alternatives. In order to place the project within the context of its watershed, the study should have a scope that extends beyond the boundaries of the proposed mine site. As part of the study, applicants should:

- Characterize both surface and subsurface flow regimes and surface-ground water interactions on a seasonal or monthly basis. Identify critical low flow conditions.

- Distinguish the effects that any current or historic mining activities have had on the hydrology of the project area

- Determine the extent to which different physical variables within the watershed control hydrological processes

- Prepare an analysis of meteorological records that describes the seasonal variability, frequency, and intensity of storm events.

Table 7. Data Needs for NEPA Review and CWA Permits		
Resource Area	**Data Needs**	**Appendix**
Climate	Average annual precipitation; Monthly precipitation distribution; Mean monthly temperature; Mean monthly evaporation; Storm characteristics (precipitation rates); Orographic effects.	A
Geology and Soils	Lithology and mineralogy of rocks, soils, and alluvial deposits; Rock unit distribution; Structural relations; Fracture distribution & characteristics; Alteration and mineralization, including vertical and lateral changes; Surface-subsurface relationships; Topography and slopes; Soil cover (depth and type).	C
Surface Water Hydrology	Watershed delineation; Flood plain delineation; Identification of special designation waters; Stream gradient, channel morphology, channel pattern; Stream flow/sediment transport relations; Stream flows (average monthly flow, critical low flows); Flood frequency; Precipitation/infiltration/ runoff relations; Gaining/losing reaches; Surface water usage.	A, B
Ground Water Hydrogeology	Aquifer delineation; Aquifer characterization (storage, direction of flow, gradient, permeability, transmissivity); Water table elevation and its variability; Recharge zones; Confining layers; Seeps & springs; Depth of permafrost thaw; Ground water usage.	A, F
Surface Water and Ground Water Quality	Background surface and ground water quality; Existing surface and ground water quality; Relationship of surface water quality to changes in flow	A,B
Effluent Quality	Expected quality of effluents and variability of effluent quality over range of operating conditions; Expected flow of effluent and variability of flow over range of operating and climatic conditions	D
Wetlands & Waters of the U.S.	Delineation of wetlands & waters of the U.S.; Wetlands classification; Designation of riparian habitat & corridors; Narrative descriptions that include nature, extent, functions, and value.	I
Aquatic	Fish and macroinvertebrate population and diversity data; Aquatic habitat characterization; aquatic mammals and amphibians; Threatened, endangered, or sensitive species.	G

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Table 8. Testing Needs for NEPA Review and CWA Permits		
Resource Area	**Testing Needs**	**Appendix**
Solid waste characterization (e.g., Waste Rock, spent heap leach & Tailings)	Grain-size distribution; mineralogy, Total and sulfide sulfur content; Acid generating potential; Acid neutralizing potential; Kinetic test; leach tests; Total metals content; Leachate compositions; Tailings water compositions.	C
Rock, Soils & Sediment Characterization	Proctor moisture/density; Atterberg limits; Grain-size analysis; Direct shear; Permeability; Total metals content; Acid generating potential; Acid neutralizing potential; leach tests.	C,F
Water Quality Characterization	Major cation and anion concentrations; Metals concentrations (total and dissolved); pH; conductivity; Redox potential; Temperature; Total hardness; Total alkalinity; TDS; TSS; Dissolved oxygen, Whole effluent toxicity (WET) tests.	A,B, D
Hydrologic Characterization	*In situ* hydraulic conductivity; Monitor well logs; Drawdown studies; Aquifer transmissivity and storage.	A

The baseline study should provide adequate data to evaluate whether the proposed mine operation and considered alternatives could alter the hydrology of a watershed. This analysis requires characterization of several watershed geomorphological and other characteristics, such as basin slope, vegetative cover, soil type and land use conditions. In addition, applicants need to demonstrate how construction of the proposed mine and its associated facilities might alter runoff responses to both average and extreme precipitation events. Impacts to seasonal flow regimes and channel morphology (i.e., channel bed and bank erosion and sediment transport capacity) that can be caused by stream diversions, channelization, and altered drainage patterns need to be defined. Effects on surface water discharge, and impacts to spring-fed wetlands or stream reaches from mine dewatering activities should also be quantified.

Applicants must determine whether their proposed operation will result in discharges to waters of the U.S.. An accurate assessment is accomplished by developing a thorough understanding of local and regional hydrology and formulating a reliable water balance. An adequate water balance superimposes the flow of process system waters (i.e., the process circuit) on the natural hydrology within the watershed and describes the management of storm runoff, flood flows, and process and storm water discharges on a seasonal or monthly basis.   The water balance should cover the range of hydrologic conditions (extreme and average) and potential variations or disruptions in process flows (e.g., temporary suspension of operations as well as

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closure). The site water balance is used to determine whether a proposed mine would have a net gaining system that may require continual or periodic discharges.

Table 9. Preliminary Design Needs for NEPA Review and CWA Permits

Resource Area	Preliminary Design Needs	Appendix
Mine Operation	Mine plan; Facilities layout.	-
Infrastructure	Road locations and construction; Stream crossings; Fuel storage; Borrow areas; Water and wastewater treatment plants.	-
Beneficiation	Mineral processing methodology; Reagent storage; Facility construction; Conveyance systems; Ore and concentrate stockpiles.	-
Waste Disposal	Tailings impoundments and piles; Waste rock and spent ore dumps; Overburden storage areas.	F
Process Water Management	Process water flow chart; Storage ponds; Conveyance structures; water balances	D,E
Storm Water Management	Diversion structures; Conveyance structures; Retention ponds.	E
Closure and Reclamation	Best Management Practices; Heap leach neutralization and rinsing; Revegetation mixes; Grading and recontouring; Natural and synthetic covers; Facility removal; Pit wall or mine tunnel stabilization.	E, F, H

Methods to measure and predict hydrological impacts and develop a site water balance are described in Appendix A, *Hydrology*. Region 10 recognizes that many mines proposed in northern and central Alaska are likely to be situated in areas underlain by permafrost. In these terrains, stream flow and precipitation-infiltration-runoff relations vary seasonally due to winter freeze. Applicants proposing to work in these areas should give special consideration to their unique hydrological characteristics and to seasonal variations.

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Table 10. Data Analysis Needs for NEPA Review and CWA Permits		
Resource Area	**Data Analysis Needs**	**Appendix**
Waste Rock & Tailings Disposal Impact	Predict short- and long-term acid generating potential and metals leachability; rates of seepage and run-off; predict stability of piles, impoundments, and backfill	C,F
Surface Water & Ground Water Quality Impact	Statistical analysis of water quality data; Estimated effluent discharge composition; Estimated seepage composition; Projected effects of discharge on ground and surface water quality; Estimated pit-lake water quality; Projected likelihood of ground and surface water quality impacts from spill events.	A,B,D
Hydrological Impacts	Facility water balance; Design storm models; Watershed model (e.g., HEC-1); Flow duration curves; Pit lake development model; Ground water flow model (e.g., MODFLOW); Storm water flow model; Sediment erosion and transport model; Dewatering, drawdown, and recovery; Changes in recharge characteristics.	A,H
Wetlands & Aquatic Life Impact	Calculated impacted acreage by wetland type, loss of function and value. Potential impacts on fish and macroinvertebrate populations through toxicity, reduced flow, and habitat loss.	B,I, G

6.1.2 Ground Water Hydrogeology

A proposed mining operation can impact the availability and flow of ground water by locally lowering the water table through dewatering operations; disrupting aquifers; locally removing confining layers; and altering zones of natural recharge (Brown, 1997). Mining activities also create opportunities for ground water contamination by exposing aquifers and puncturing aquitards. Alteration of ground water flow direction or reduction in the water table or potentiometric surface can potentially impact wetlands, aquatic habitats, and stream discharge characteristics.

Most applicants will be required to submit a detailed hydrogeologic study of the region in which they are proposing to operate. This study and its associated data needs are summarized below and described in detail in Appendix A, *Hydrology*.

The *hydrogeological study* should provide a baseline from which to measure or predict changes that might occur as a consequence of the proposed action and its alternatives. It should have a scope that extends beyond the boundaries of the proposed operation. As part of the study, applicants should:

C Identify aquifers and confining layers and their vertical and lateral extent

C Determine the types of aquifers (confined or unconfined), aquifer characteristics such as hydraulic conductivity, primary and secondary porosity, storage coefficients, and hydraulic gradient, and hydraulic communication, if any, with surface water or other ground waters

C Characterize each confining layer and its physical properties

C Determine the depth to water, the configuration of the water table or potentiometric surface, and the hydraulic gradient and flow direction

C Where required, quantify the seasonality of ground water flow in permafrost terrains

C Distinguish the effects that any current or historic mining activities have had on the hydrogeology of the project area.

Region 10 expects applicants to provide analyses of potential impacts to ground water resources caused by water use and mine dewatering. Dewatering of surface and underground mines can deplete aquifers, impact ground water recharge and discharge, and locally change the direction of ground water flow. For these reasons, data collected for hydrogeological studies should be used to conduct an analysis of the potential impacts of drawdown. This analysis should determine the extent that ground water levels or specific yield would be affected and whether lowering of the water table or reducing the potentiometric surface would impact spring flow, wetlands, gaining stream reaches, or other ground water users. In some cases, an analysis of geotechnical effects caused by drawdown may be required to adequately design mine facilities, impoundments, embankments, and foundations. For example, dewatering a comparatively thick, unconsolidated alluvial aquifer that overlies an undulating bedrock surface, could cause differential compaction, consolidation, and uneven surface subsidence. These effects could threaten the geotechnical stability of facilities such as tailing dams and the integrity of engineered structures such as process pond liners. Data collected during dewatering operations should also be used to predict the rate at which the ground water system is expected to recover following active operations.

Hydrogeologic studies conducted in terrain underlain by permafrost will need to characterize the conditions unique to this sensitive environment. Included are the seasonality of ground water flow in the near surface environment, the depth of annual thaw, potential connections between shallow and deep (below the permafrost layer) ground waters, the

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importance of vegetative layers, and the potential for mining-induced thawing of frozen materials (either by excavation of insulating vegetation or rock layers or construction of permanent facilities such as tailings impoundments).

The hydrogeologic study should provide a basis for assessing the recovery of the ground water regime following mining. This includes estimating the rate at which ground water levels would recover and describing potential effects caused by the formation of pit lakes, the disruption of recharge zones (especially those associated with confined aquifers), the influx of seepage waters from permanent mine facilities (e.g., tailings impoundments), the removal of confining layers, the disruption of aquifer continuity, and the back-filling of mine pits (Siegel, 1997).

6.2 Impacts to Water Quality

Impacts to surface and ground water quality can occur from discharges of storm water, mine drainage, and process water. Two issues that applicants will be required to address during the NEPA review and CWA permitting processes are whether the proposed project is expected to lead to a discharge of wastewater and whether the proposed project would create short- or long-term impacts to surface or ground water quality. EPA places great emphasis on evaluations of potential wastewater discharges because once mining operations have been initiated, discharges often cannot be stopped or reduced if the effluent does not meet water quality standards. Historically, the most problematic discharges occur from major mine components that are exposed to the atmosphere, such as mine pits, waste rock dumps, tailings impoundments, and leach facilities. Because mine wastes will be exposed to the elements long after mine closure, the potential for the release of metals, acid, cyanide, sediment, or other contaminants from a mine site must be accurately analyzed. Evaluating the potential for long-term risk from waste disposal practices is a difficult task, but it is of primary importance to demonstrating compliance with the CWA and in disclosing accurate information to the public. Factors associated with evaluating long-term impacts include:

- Characteristics of waste rock, tailings, and other waste materials
- Facility design and construction
- Beneficiation and processing methods
- Local meteorological and hydrological conditions
- Solid waste and wastewater management methods.
- Closure and reclamation methods.

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Determining potential impacts to water quality typically requires applicants to collect a variety of data, conduct numerous geochemical tests, develop preliminary mine plans and facility designs, and perform different types of data analyses. In general, applicants should anticipate that they may be required to provide studies that characterize:

- Background surface and ground water quality within the watershed hosting the proposed operation

- Background surface water hydrology and ground water hydrogeology in the watershed of interest

- Expected hydrologic, physical, and geochemical behavior of waste rock piles, heap leach piles, and tailings impoundments, and other waste materials during operation and following closure

- Chemical compositions of process waters, mine drainage, and treated and untreated effluent

- Effectiveness of rinsing, neutralization, and closure and reclamation methods employed for these facilities

Each of these items are discussed in the following subsections.

6.2.1 Background and Existing Water Quality

Methods to determine background and existing water quality in a watershed are discussed in Appendix B, *Receiving Waters;* testing needs and data analyses are summarized in Tables 8 and 10. As described in the appendix, applicants should employ robust statistical techniques to analyze background metals and other constituent concentrations in different portions of a potentially impacted watershed, quantify the magnitude of seasonal variability in water quality and variation associated with high and low stream flow conditions, and evaluate water quality under the conditions of highest risk (i.e., worst-case conditions). Adequate quality assurance and quality control should be demonstrated. For example, analytical methods employed must be sensitive enough to measure the parameters of concern at levels at or below the water quality criteria.

6.2.2 Regional Hydrology and Hydrogeology

The hydrology and hydrogeology studies described in Section 6.1 should provide data to evaluate potential future water quality impacts. Applicants for NPDES permits should develop a surface water management plan and site water balance that also can be used when evaluating potential water quality impacts.

6.2.3 Hydrology of Mines and Waste Facilities

Predictions of whether and when a mine or waste disposal facility may begin to generate acidic water or to release metals or other constituents are related to the flow of fluids through the facility, the compositions of these fluids, the compositions of the materials with which the fluids are in contact, and the chemical environment in which the fluids exist. Accurate predictions of effluent flow rate and discharge composition require knowledge of waste characteristics, surface and ground water hydrology, effectiveness of proposed surface water and ground water controls, final unit construction and closure methods, climate, geochemical equilibrium, and other variables that may be difficult to determine during the permitting process. Consequently, applicants should employ facility designs that minimize infiltration and seepage and use conservative estimates for acid generation potential, rainfall, and leachate composition to determine future impacts.

In general, the hydrological and hydrogeological studies described in Section 6.1, and in more detail in Appendix A, will provide data to determine the likelihood that lakes will form in open pits and that underground workings will flood when mining ceases. Although the rate at which lake filling or underground flooding is expected to occur can be estimated from knowledge of pre-mining ground water flow, data collected during actual dewatering operations can be used to provide a clearer picture of the expected post-closure conditions.

The long-term hydrological behavior of waste rock dumps and tailings impoundments depends on factors such as construction method, grain size and sorting of the waste materials, secondary mineral formation, and closure and reclamation methods (Blowes et al., 1991; MEND, 1995; Swanson et al., 1998). Predicting seepage rates can be difficult, especially for facilities that are likely to be partially saturated, such as those located in dry climates (Swanson et al., 1998). Generating acceptable model simulations is even more complicated for facilities constructed in such a way that they are physically heterogeneous (e.g., discontinuous layers of coarse and fine waste rock) (Swanson et al., 1998) or within which layers of secondary mineral cements formed during weathering (Blowes et al., 1991). More detail regarding the prediction of hydrologic impacts of waste rock dumps and tailings impoundments is provided in Appendix F, *Solid Waste Management* and Appendix A, *Hydrology*.

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6.2.4 Solid Waste and Materials Characterization and Management

Applicants will need to demonstrate that they have adequately characterized their waste materials and the potential for these materials to contribute to discharges to surface waters and groundwater. Tests commonly used to characterize bulk chemical and physical composition, metals leachability, and acid-generating potential are summarized in Tables 8 and 10 and described in Appendix C, *Characterization of Ore, Waste Rock, and Tailings.* Because there are many different tests available to determine leachability and acid-generating potential and no single accepted way of interpreting test results, applicants should consult with federal and state regulatory agencies to enquire whether specific test methods are preferred.

Applicants should demonstrate that the samples characterized are representative of material that will be produced during operations. There are no set guidelines for determining the number of samples that should be tested. Recent studies suggest that the number of tested samples should be determined by the compositional variability of the materials that will be disposed of (Shields et al., 1998). Applicants are expected to describe the variability inherent to different lithological units across the project area (e.g., homogeneous, unzoned granite vs. heterogeneous colluvium) and that may have been imparted to a lithological unit through weathering, hydrothermal alteration, and mineralization. Applicants will need to consider how vertical and lateral changes in the intensity and style of mineralization and host rock alteration affect the acid generating characteristics and metals leachability of each geologic unit at the proposed mine site. Because compositional variability equates primarily to mineralogical variability, applicants can use inexpensive visual examination (e.g., petrographic microscope) to quantify the range and median proportions of acid-forming, acid-neutralizing, and metal-bearing constituents in the various lithological units that will be encountered. Testing programs can then focus on characterizing the expected behavior across the compositional range identified for each rock type.

For many large-scale operations, it may be appropriate to formulate composite test samples which represent waste rock and overburden materials as they are likely to be excavated and handled during the mining operation. It is important that composite samples be created in a manner representative of the proposed operation.

Tailings test samples should be taken from pilot-scale metallurgical tests representative of the operation that will be employed during full-scale operation. Applicants should test ore samples that capture the range of ore grades that will be processed during the life of the mine.

Of particular concern to EPA and the public is the potential for waste rock, tailings, and heap leach materials to generate acidity and release metals after protracted exposure to the environment. Tests of several years duration conducted on mine materials indicate that acidification may occur after periods of neutral drainage lasting one to two years (Lapakko et al., 1998), even in the accelerated weathering environment of the lab. Applicants should recognize that static acid-base accounting tests provide information only on the relative proportions of acid-forming and acid-neutralizing components in a sample and provide no information regarding the rates at which these reactions are expected to occur. Information regarding the latter can only be obtained by kinetic tests that are conducted for a sufficiently long time. Kinetic tests typically are conducted for 20-week periods; however, there is a trend toward using longer test times (Price et al. [1997] advocate 40-week tests) that would be viewed favorably by Region 10.

The results of static and kinetic tests are particularly sensitive to the test method and laboratory technique. EPA Region 10 encourages applicants to conduct all tests using the same test method and testing laboratory. In addition, although not specifically stated in most kinetic test procedures, Mills (1998) points out that it is typical for splits of the starting kinetic sample and final leached product to be tested for static acid-base properties and total metals. Mineralogical analyses also should be conducted on these samples because these data can provide important constraints to assist the interpretation of test results.

Interpreting the results of leach tests, static acid-base accounts, and kinetic tests is not straightforward and there are no generally accepted criteria for doing so (see Appendix C). This is because the conditions simulated by the tests inevitably will deviate from the environment in which wastes will be disposed and because many test methodologies require that samples be crushed or ground to particle sizes significantly finer than produced by the mining operation (Doyle et al., 1998; Lapakko et al., 1998). Changes in particle size are particularly important, because crushing alters the exposed surface areas of both acid-forming and acid-neutralizing materials, which in turn affects reaction rates and availability (Lapakko et al., 1998). To ensure that interpretations of geochemical test results are appropriately conservative, applicants should carefully consider the representativeness of the tested samples, the similarities and differences between the test conditions and site environment, and the significance of any temporal changes in leachate compositions noted over the course of the tests.

Management of solid wastes and information needs related to NEPA analyses of potential impacts due to solid waste are discussed in Appendix F, *Solid Waste Management*. Applicants proposing operations that will produce acid- or metals-generating waste rock or tailings should provide design elements that will limit potential environmental impacts from these materials. These could include steps to minimize the production of potentially reactive wastes, separation and special handling of these materials, and/or reclamation designed to isolate these wastes from the environment.

6.2.5 Wastewater Quality and Management

The NPDES permit process requires applicants to identify sources of wastewater and storm water, describe wastewater and storm water management, provide water balances, and estimate

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the quantities and compositions of effluents that would be discharged through permitted outfalls throughout the year (see Table 5). Applicants must demonstrate that the wastewater characterization is representative of discharges that will occur over the full range of operating conditions and closure and that any effluent proposed for discharge will not result in water quality standards exceedences in the receiving water. In order to accomplish this, applicants will need to estimate the quantities and compositions of process solutions, tailings water, runoff waters, mine drainage, and treated effluent at the proposed operation and the effectiveness of wastewater management measures (such as treatment).

Wastewater quality and quantity from tailings impoundments and operating heap leach facilities may be determined from analysis of process solutions and tailings waters obtained from pilot-scale metallurgical tests that simulate the proposed processing operations. Discharges from waste rock piles and mine drainage may be predicted based on geochemical testing and modeling. For operations proposed in areas of historic mining activity, samples of mine drainage should be collected from pit lakes, underground workings, tailings ponds, or seeps emanating from existing waste disposal facilities. Where wastewater treatment is proposed, the quality of treated effluent should be determined from pilot-scale tests of the proposed treatment technology. Wastewater management, including discussions of treatment processes, treatability studies, methods for disposal, and data needs for NEPA analyses are discussed in Appendix E, *Wastewater Management.* Methods to predict discharge effluent quality are described in Appendix D, *Effluent Quality*.

6.2.6 Post-Closure Mine and Waste Facility Water Quality

Predictive assessments of post-mining pit lake or underground water quality and tailings impoundment water quality will likely be required by the NEPA process. Predictions may be made based on results of geochemical testing and modeling. There may be a high degree of uncertainty associated with predictive modeling. Stochastic models, those containing information regarding parameter uncertainty, are gaining wider acceptance as predictive tools (Schafer and Lewis, 1998). Where models are used, assumptions and uncertainties associated with the model and input parameters must be identified. It is also beneficial for the Applicant to make sure in advance that the model will be accepted by the regulatory agencies.

Mining activities that disrupt ground water geochemical systems can spur mineral dissolution or precipitation reactions that can alter pre-mining ground water quality in ways that may be difficult to predict (Lewis-Russ, 1997). Mine pits that are backfilled with waste rock and underground workings that are abandoned following ore extraction increase the opportunity for contamination by exposing ground water to fresh rock surfaces that are not in equilibrium with the existing geochemical system. In these situations, applicants should provide an assessment of potential ground water quality impacts in these settings.

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More detail regarding predictive water quality models is provided in Appendix D and Appendix A.

6.2.7 Closure and Reclamation Effects

The methods used for facility closure and reclamation can play an important role in determining the potential for long-term contamination. Residual leach fluids or soluble metal complexes that remain in inadequately rinsed or neutralized heaps can lead to seepage of metals-laden acidic or cyanide-rich fluids. However, low permeability caps, covers, and capillary barriers installed following recontouring can lower the risk of long-term contamination by helping to reduce infiltration and chemical flux through the embankment. In addition, adequately established vegetation cover would reduce erosion and aid in the evapotranspiration of water from surface layers. Caps and covers also can help to limit oxygen diffusion into sulfide-bearing waste materials. Grading and recontouring of facility slopes can reduce the potential for long-term erosion, slope failure, and sedimentation in surface waters. Other Best Management Practices (BMPs) may be employed to minimize contamination due to sedimentation and erosion (see Appendix H). Applicants will be required to develop preliminary closure and reclamation plans for NEPA review which should address whether or not an NPDES permit will be required for any post-closure discharges. Closure considerations and related NEPA disclosure needs are discussed in more detail in Appendix F, *Solid Waste Management* and Appendix H, *Erosion and Sedimentation.*

6.3 Impacts to Aquatic Resources

Freshwater aquatic resources represent an important component of the environment that must be analyzed for NEPA review and CWA permitting processes. Considerable overlap exists between studies analyzing aquatic resources and those characterizing surface water and ground water quality and hydrology. Many impacts to aquatic resources, including riparian areas, are related to mine construction and the location of facilities. Road construction, logging, and clearing of areas for buildings, mills, and process facilities can reduce infiltration and increase the amount of surface runoff which reaches streams and other surface water bodies while potentially reducing stream base flows. This can increase the peak flow and the total amount of stream discharge which occurs from a given storm event. Unusually high peak flows can cause erosion of stream banks, widening of primary flow channels, erosion of bed materials, channelization, and alteration of the slope of the channel. These impacts can affect and degrade aquatic habitats, including riparian zones. Channelization (i.e., straightening) can increase flow velocities in a channel reach, potentially affecting fish passage to upstream reaches during moderate to high stream flows. Increased erosion and downstream sedimentation can impact spawning gravels, egg survival, and frye emergence, as well as degrade benthic food sources and riparian cover. Flooding can create high velocity flows, scour stream banks and erode or bury

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gravel substrates. The destruction of cover created by large woody debris and stable banks can impact rearing and resting habitat for fishes. In addition, removing riparian vegetation can reduce shading. The resulting increase in sunlight can raise the temperature at the surface and through the entire water column, and this in turn can have a profound impact on the entire aquatic ecosystem.

Water quality issues associated with mine exploration, operation, and abandonment activities typically involve the potential discharge of mine water and process solutions, increased loads of metals and other toxic pollutants, acid generation from waste rock, spent ore, and mine workings. If these pollutants reach surface waters, toxic conditions could affect important aquatic species.

Studies that are typically required for NEPA review and often CWA §404 permitting include analyses of fish, benthic macroinvertebrates, and the physical parameters, including the riparian zone, that define habitat for aquatic communities. In the NEPA process, aquatic resources, especially fish, often represent significant issues for the proposed action being evaluated. This is because resident and anadromous fisheries represent a concern to the public and governmental agencies such as NMFS, BLM, USFWS, U.S. Forest Service (USFS), Tribal Commissions, and state wildlife agencies. Many fish species, particularly salmonids (trout and salmon), have important recreational and/or commercial fishery values. Numerous species also are Federally or state-listed species that require protection under the Endangered Species Act. For these reasons, applicants should complete analyses to determine potential impacts to aquatic resources. Appendix G, *Aquatic Resources* provides detailed discussion of data needs and outlines methods to design appropriate studies for aquatic resources.

The *aquatic resources study* should provide a baseline from which to measure or predict changes that might occur as a consequence of the proposed action and its alternatives. As required under NEPA regulations, an impact assessment must analyze both direct, indirect and cumulative impacts to important aquatic resources located within the project study area (Council on Environmental Quality, 1986). The study should have a scope that extends beyond the boundaries of the proposed mine site. Applicants should anticipate that they could be required to provide studies that characterize or evaluate:

- Potential effects of water quality changes on aquatic communities and their habitat that may result from mine operations, including point and non-point source discharges, and changes in flow regimes. Parameters of concern may include heavy metals, pH, total dissolved solids, cyanide and cyanide breakdown products (e.g., ammonia, nitrogen compounds), and overall effluent toxicity.

- Potential effects of sedimentation on aquatic communities and their habitat as a result of construction and operational activities.

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- Potential effects of physical disturbance or removal of aquatic habitat and associated riparian area on aquatic biota.

- Potential effects to aquatic biota from spills that occur during the transport or storage of fuel, process chemicals, and other hazardous materials.

- Potential effects of stream flow changes on aquatic habitat and biota that result from water withdrawals (both of ground and surface water), stream diversions, or discharges.

- Potential effects of physical blockages or barriers created by mine construction or operation activities on fish movements. These evaluations should include potential velocity barriers that can be created in diversions, culverts, or road crossings which can affect fish passage through a stream reach.

These types of impact evaluations would normally include background studies that define fish distribution, abundance and species composition, and critical habitat for spawning, frye emergence, and juvenile rearing. These studies need to focus especially on game and species listed as threatened and endangered (T&E) or special status. Fishery habitat studies should include, among other factors, characterization of stream gradients, widths, depths, pool frequency, substrate composition, instream and riparian vegetation, and the presence of large woody debris. Background studies to characterize macroinvertebrate communities should define species composition and abundance and provide community metric data, such as species richness and species diversity.

6.4 Impacts to Wetlands

Studies to define, delineate and determine potential impacts to wetlands and other waters of the U.S. typically have more rigorous requirements than studies conducted to evaluate non-wetlands because jurisdictional wetlands (and other waters of the U.S.) are regulated under Section 404 of the CWA. In general, wetlands are aquatic areas within the landscape that include swamps, marshes, fens, bogs, vernal pools, playas, prairie potholes, and riparian zones. These features are considered to be “jurisdictional wetlands” if they exhibit specific conditions of wetland hydrology, hydric soils and the presence of hydrophytic vegetation, as defined by the accepted delineation method. The regulatory definition of wetlands and the criteria and indicators used to identify them are discussed in detail in Appendix I, *Wetlands and Other Waters of the United States*. Regulatory requirements as specified under §404 of the CWA are discussed in section 3.0.

Wetlands may perform a variety of important physical, chemical and biological functions including ground water recharge or discharge, flood storage, peak flood flow attenuation, shoreline and channel bank anchoring, dissipation of erosive forces, sediment trapping, and nutrient trapping and removal. Wetlands may also provide habitat for numerous plant, wildlife, and fish species, including some that are listed as threatened and endangered (T&E).

Impacts to wetland areas can result from the construction and operation of mine and facilities including construction and use of roads; site preparation for buildings, mills and ancillary facilities; and the construction, use and maintenance of waste and storage facilities, such as tailings impoundments and waste rock dumps. Impacts can occur either directly or indirectly. Direct impacts include the removal or destruction of wetlands through dredging, filling, or draining. Indirect impacts are those associated with increased runoff and erosion from disturbed areas, increased sedimentation, and increased loadings of metals and other toxic pollutants. Mining operations also can impact riparian areas, which may be destroyed or lost by the construction of stream diversions or by altering drainage patterns within a watershed. Mine dewatering activities may impact wetland hydrology and wetland functions by altering regional ground water recharge and discharge characteristics.

Any proposed project or activity with a potential to impact wetlands, either directly or indirectly, will be required to fully characterize this resource to establish baseline conditions, and determine potential impacts. It is important to note that state and local governments may also place restrictions on projects that could impact wetlands, regardless of their jurisdictional status under CWA §404.

The *wetland study* should provide a baseline from which to measure or predict changes that might occur as a consequence of the proposed action and its alternatives. Studies to determine potential impacts to wetlands should be described in terms of acreage of absolute loss (acres filled or drained) and in loss of wetland function. Applicants should anticipate that they may be required to provide studies that characterize or determine:

- The classification of wetlands and their function both within and near the project area

- The acreage of wetlands that will be directly impacted by fill or draining activities

- The extent that changes in hydrology, drainage patterns, or stream discharges would affect the hydrology of identified wetlands and the composition of associated plant species

- The extent to which dewatering activities or ground water withdrawals would affect wetland hydrology and function

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- Potential increased sediment loading to identified wetlands

- Fate and transport of spilled process chemicals or hazardous wastes and the potential for spills to impact wetlands

- Potential effects to aquatic and terrestrial wildlife habitat and habitat values from impacted wetlands.

In conducting studies, applicants should specifically evaluate different mine layouts, facility designs, and technologies to study the avoidance and minimization of environmental impacts to wetlands. The Section 404(b)(1) guidelines indicate that 404 permits can only be issued when no practicable alternatives exist that would have fewer adverse impacts to wetlands. Where proposed activities cannot avoid impacts to wetlands, studies must demonstrate that practicable steps have been taken to minimize potential adverse impacts.

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